

# STEP

## Science & Technology Education Program

### Annual Report FY02



S Science &  
T Technology  
E Education  
P Program

*Science Education in the National Interest*

## Cover photos

*Top: The three LLNL College Cyber Defenders students in FY02. (Page 16)*

*Center: The construction of the Edward Teller Education Center building in Livermore. (Page 88)*

*Bottom Left: Senator John Glenn with MARA and ROTC participants during an FY02 visit to LLNL. (Page 55)*

*Bottom Right: Hal Graboske, acting Deputy Director for Science and Technology, chats with a UC Berkeley student at the 2002 Student Research Symposium. (Page 110)*

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The logo consists of a solid blue horizontal rectangle. The word "STEP" is written in white, bold, italicized, sans-serif capital letters across the right side of the rectangle.

**Science & Technology Education Program**

# **Annual Report FY02**

*January 2003*



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## Overview

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## Introduction

The Science and Technology Education Program (STEP) at Lawrence Livermore National Laboratory (LLNL) serves as a resource to students, teachers, and faculty by facilitating research interactions with Livermore's world-class scientific facilities and staff. STEP also supports the science-educational needs of the local and regional communities surrounding the Laboratory.

STEP's programs and projects are directed toward

- facilitating research internships for college students entering careers important to the intellectual capability required by the Laboratory's national-security mission and
- enhancing science-education and -literacy activities through partnerships with the local and regional K–14 academic institutions surrounding the Laboratory.

The programs and projects that support these goals are discussed in detail on the STEP Web site at <http://step.llnl.gov/>. The common theme of STEP's science-education efforts is integrating education, research, and career options at all school levels—pre-college, undergraduate, and graduate school.

During FY02, STEP's college research internships hosted 170 college, university, and military academy students participating in one or more research programs at LLNL, as listed in Table 1.

**Table 1: FY02 College Student Research Internships**

Internship Projects	Number of Interns
National Nuclear Security Administration/Defense Programs/Office of University Partnerships—Laboratory Critical Skills Development Program	
Advanced Simulation and Computing Pipeline	15
College Cyber Defenders	3
Inertial Confinement Fusion Experimental Internships	7
Interns for Defense Technologies	11
Internships in Terascale Simulation Technology	48
Laser Science and Technology Student Program	5
National Ignition Facility Laser Internships	1
Nuclear Science Internship Program	15
Systems Administration Computer Support	5
LLNL National-Security Directorates	
Computational Materials Science and Chemistry Summer Institute	11
High-Energy-Density Physics Program	14
LLNL National Security Office	
Military Academic Research Associates	24
Reserve Officer Training Corps	11
<b>Total</b>	<b>170</b>

During FY02, STEP's science-outreach and teacher-education projects engaged approximately 13,000 students and 1,000 teachers, as listed in Table 2.

**Table 2: FY02 K-14 Education Projects**

Science Outreach (K-12 Students)	Number of Participants
California State Summer School for Mathematics and Science	30
Crystals for the Classroom	90
Expanding Your Horizons	983
Explorer Post	10
Exploring Your Future Conference	360
Fun With Science	8,980*
Future Scientists and Engineers of America	75
Math Challenge	100
Science on Saturday	1,700*
Student Research Academy	25
Tri-Valley Science and Engineering Fair	272
<b>Total</b>	<b>12,625</b>

K-14 Education (Teachers)	Number of Participants
Computer Technology Workshops	200
Crystals for the Classroom	2
Educational Partnerships	100
Edward Teller Science Education Symposium	125
Faculty Research Experiences	4
Great Explorations in Math and Science	72
Groundwater Monitoring and Assessment Program	60
Laser Science and Optics in the Classroom	20
Promoting Achievement Through Hands-On Science	320
Teacher Research Academy	10
University of California/Community College/Central Valley Education	120
Web Tech Academy	19
<b>Total</b>	<b>1,052</b>

\*Teachers, parents, and students

## Critical Skills Internships for College Students (Section 1)

Most of the college internships listed in Table 1 are funded directly by the National Nuclear Security Administration (NNSA)/Defense Programs (DP)/Office of University Partnerships (OUP) through its Laboratory Critical Skills Development Program. College students are recruited for these internships to support the specific recruiting needs of the Laboratory's NNSA programs.

These internship projects target undergraduate and graduate college students with "critical skills" in four major disciplines: chemistry and materials science, computer science, engineering, and physics and are managed within Livermore's Critical Skills Internship Program (CSIP) (<http://csip.llnl.gov/>).

The DP/OUP-funded projects described in Section 1 resulted in 27 of the 236 students who have participated in internships during the last three fiscal years (FY00–FY02) being hired into either flex-term or career positions at LLNL. This represents a student hiring rate of 10–15% per fiscal year.

Appendix 1 summarizes how STEP and the sponsoring technical organizations offer student interns a number of lectures and seminars to help the interns develop their research and career goals. All events offered to the interns are based on the Laboratory’s mission-oriented sciences.

As explained in Appendix 3, student interns are given the opportunity to have their school and LLNL research accomplishments listed on the CSIP student portfolio Web site (<http://internships.llnl.gov/portfolio/>).

Appendix 4 describes the end-of-summer evaluation of each internship project listed in Table 1. The purpose of the assessments is to provide both individual and collective evaluations of the programs. Assessment tools include measuring student learning, measuring student satisfaction or ratings of the internship experience, and evaluating the program administration.

STEP also assists various program elements within the Laboratory’s Stockpile Stewardship Program, such as computational materials science and high-energy-density physics (HEDP), in developing recruiting programs within the critical skills of interest to each sponsoring element.

For example, Section 1 explains how the successes of the FY01 and FY02 HEDP Program led LLNL to conduct a HEDP Summer School (HEDPSS) aimed at staff researchers who are new to the field, advanced graduate students, and postdoctoral researchers. The 2002 HEDPSS (<http://www.llnl.gov/adiv/HEDPSS/>) took place from August 4 to 16 at the University of California (UC) at Santa Cruz and was cosponsored by the UC Santa Cruz Department of Astronomy and Astrophysics and the Hertz Foundation.

## Military Academic Research Associates/Reserve Officer Training Corps (Section 2)

STEP also works with Livermore’s National Security Office to contribute to common mission goals between the Department of Defense (DoD) and the Department of Energy (DOE) by providing internship opportunities for college students in the Reserve Officer Training Corps (ROTC) and U.S. military academy cadets and midshipmen.

Section 2 describes the Laboratory’s ROTC Day, which is part of the continuing efforts of Livermore’s National Security Office to strengthen the relationship between LLNL and DoD. ROTC Day is a component of the ROTC internship project, where cadets and midshipmen participate in internships at national-security laboratories (Livermore; Los Alamos National Laboratory [Los Alamos]; Sandia National Laboratories; and recently, Oak Ridge National Laboratory and Idaho National Engineering and Environmental Laboratory).

## Science Outreach and K–14 Education (Section 3)

Livermore’s K–14 science-education and -literacy activities play an important role in the creation of future scientists, engineers, and technicians in areas of special interest to the Laboratory.

Through local and regional education partnerships, STEP leads the Laboratory's education efforts to stimulate greater interest in science and science careers. These science-outreach and educator projects are funded by the Laboratory's general and administrative distributed budget.

Section 3 describes the objectives and accomplishments of the student and teacher projects listed in Table 2. One example is Educator Day, where K–14 educators and state legislative representatives from throughout the San Joaquin Valley attended presentations highlighting Laboratory resources that are available to support science instruction. Educator Day participants learned that Merced College has sent faculty members to Livermore for sabbaticals and that STEP has established a scientific-equipment loan program with Merced College. The equipment will be used to develop student training programs in optics, biotechnology, environmental science, and computer science technology.

## Edward Teller Education Center (Section 3)

The Edward Teller Education Center (ETEC) (<http://etec.das.ucdavis.edu>) is a UC collaborative that was established to provide professional-development instruction in science and technology to K–14 teachers. ETEC is funded by the UC Office of the President and is operated by UC Davis, UC Merced, and LLNL.

Section 3 describes how STEP and ETEC have collaborated to offer a variety of K–14 teacher professional-development programs on topics ranging from computer technology to basic research. Moreover, STEP recently helped ETEC receive a \$50,000 grant from Washington Mutual Bank to support teacher professional development in California rural communities, such as the San Joaquin Valley and Central Valley, by providing stipends for teachers to attend workshops cosponsored by STEP and ETEC.

## Institutional Education Activities (Section 4)

STEP continues to take the lead in facilitating and piloting numerous educational initiatives at LLNL. STEP leads Livermore's Institutional Education Committee, which combines efforts throughout the Laboratory to promote student activities. STEP also maintains a Web site (<http://www.llnl.gov/education>) that provides updates about all LLNL opportunities for students and faculty.

Section 4 describes how STEP helps students prepare for graduate schools and future careers. For example, STEP acquired a site license for the test-preparation software, GRE PowerPrep, enabling STEP to offer the software to students free of charge. The opportunity to download the software, as well as 34 other career-enhancing seminars, workshops, etc. for students, is listed on STEP's Student Bulletin Board at <http://step.llnl.gov/sbb>.

A major institutional education activity managed by STEP is the LLNL Student Research Symposium (<http://step.llnl.gov/symposium>). The FY02 symposium included a program book of abstracts (UCRL-MI-149475) for all participants.

As shown in Appendix 2, the symposium posters were displayed by discipline: biology (7), chemistry and materials science (13), computation (19), engineering (14), environmental science (4), and physics (9), as well as four late submissions. Symposium attendees included students,

Laboratory employees, and recruiting representatives from UC Davis and the ASCI Alliance campuses (the University of Chicago, the University of Illinois, Stanford University, and the California Institute of Technology).

## Directions for FY03

STEP's college internships and K–14 activities have been fully integrated into the Laboratory's University Relations Program (URP) and are defined as a URP program element similar to other URP-managed programs (<http://www.llnl.gov/urp/>). This integration process began in FY02 and was completed in the first quarter of FY03.

To better communicate the alignment of the college internship projects with the mission needs of Livermore's NNSA programs, the corresponding program element within URP has been renamed CSIP, with Barry Goldman serving as the manager.

For FY03, CSIP projects have been codesigned by principal investigators in the Stockpile Stewardship Program to leverage their efforts to increase the number of U.S. citizen scientists and engineers available to fill critical-skills needs within NNSA programs. The CSIP projects for FY03 were evaluated for overlap with the structure of the DOE/DP Campaigns.

As part of the strategy to achieve the critical-skills recruiting goal, CSIP internship projects (<http://internships.llnl.gov>) in FY03 continue to target undergraduate and graduate college students within four core competencies: chemistry and materials science, computer science, engineering, and physics. These four disciplines are aligned with the stockpile-stewardship critical-skills list, created by Livermore and Los Alamos as part of the "Appendix O" discussions between UC and the NNSA.

To better align the K–14 science education and outreach activities with the needs of the local and regional communities surrounding LLNL, existing collaborations have been strengthened, and new collaborations are being established, including those that address California's statewide science-education topics.

Moreover, during FY03, STEP's K–14 manager, Richard Farnsworth, and the ETEC director, Stan Hitomi, will expand the use of STEP's student and teacher projects as a leveraging instrument for UC K–12 education partnerships (<http://www.universityofcalifornia.edu/collegeprep/welcome.html>). Because ETEC is a collaboration between UC Davis, UC Merced, and LLNL, STEP has already expanded its local education activities into California's Central Valley by combining resources with ETEC.

The Laboratory's continuing commitment to education has roots in the close relationship between LLNL and the UC system and through the realizations that (1) Livermore's leading-edge research requires the development of specific critical skills not readily available from universities and (2) the Laboratory can be a contributing partner in helping to solve the many challenges facing K–12 science education. LLNL is looking forward to further supporting the goals of NNSA/DP and continuing its role as a major contributor to the critical-skills recruitment efforts of the NNSA programs.



## Section 1: Critical Skills Internships for College Students

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### Introduction

During FY02, the Critical Skills Internship Program (CSIP) assisted in placing 170 college and university students within the following LLNL Stockpile Stewardship Program (SSP) internship projects:

Internship Projects	Number of Interns
National Nuclear Security Administration/Defense Programs/Office of University Partnerships—Laboratory Critical Skills Development Program	
Advanced Simulation and Computing Pipeline	15
College Cyber Defenders	3
Inertial Confinement Fusion Experimental Internships	7
Interns for Defense Technologies	11
Internships in Terascale Simulation Technology	48
Laser Science and Technology Student Program	5
National Ignition Facility Laser Internships	1
Nuclear Science Internship Program	15
Systems Administration Computer Support	5
LLNL National-Security Directorates	
Computational Materials Science and Chemistry Summer Institute	11
High-Energy-Density Physics Program	14
LLNL National Security Office	
Military Academic Research Associates	24
Reserve Officer Training Corps	11
<b>Total</b>	<b>170</b>

In the last three fiscal years (FY00 through FY02), 27 students have been hired at LLNL from the Defense Programs (DP) Office of University Partnerships (OUP) out of a total of 236 interns from the LLNL DP/OUP Critical Skills Development Program. (These hiring numbers do not include the students involved in the National Security Directorates Internships Projects or the Military Academic Research Associates/Reserve Officer Training Corps programs that are discussed in Section 2.)

The three-year average for the overall hiring rate (11.4%) is less than the two-year average (15%) for FY00 and FY01 (see page 7 of STEP's FY01 Annual Report [UCRL-AR-134101-01]). This decrease is due in part to the number of new internship projects in FY03 and the increase of the graduate-student-to-undergraduate-student ratio.

Projects involving community college interns have hiring rates as high as 30% or more. As would be expected, it will take more years of data to properly reflect the return on investment for internship projects involving graduate students, who typically spend five years or more working toward their doctoral degrees.

Approximately half of the 170 FY02 interns have been placed in indeterminate employment status, which allows them to return to their respective technical programs next summer and during academic school-year breaks.

In addition to the nine projects funded by the DP/OUP, there are two additional college internship projects: the High-Energy-Density Physics (HEDP) Program and the Computational Materials Science and Chemistry Summer Institute (CMSCSI). CSIP played a major role in the initial definition and implementation of recruitment efforts for internships candidates to work with various elements of the LLNL SSP within the Defense and Nuclear Technologies (DNT) Directorate.

The Materials Research Institute (MRI) at LLNL manages CMSCSI ([http://www-cms.llnl.gov/MRI/summ\\_inst/](http://www-cms.llnl.gov/MRI/summ_inst/)) in collaboration with the UC Davis Department of Applied Science (DAS). The successes of the FY02 Institute are documented at [http://www-cms.llnl.gov/MRI/summ\\_inst/successes.html](http://www-cms.llnl.gov/MRI/summ_inst/successes.html) and within this section of the Annual Report.

The important results of the HEDP internship project are being used to help define additional recruiting techniques for the Livermore HEDP workforce.

The accomplishments of the nine DP/OUP internship projects, CMSCSI, and the HEDP Program are discussed individually in this section in alphabetical order. Each of the following internship projects has a separate subsection that describes the project's goals and accomplishments.

- Advanced Simulation and Computing Pipeline
- Computational Materials Science and Chemistry Summer Institute.
- Cyber College Defenders
- High-Energy-Density Physics Program
- Inertial Confinement Fusion Experimental Internships
- Interns for Defense Technologies
- Internships in Terascale Simulation Technology
- Laser Science and Technology Student Program
- National Ignition Facility Laser Internships
- Nuclear Science Internship Program
- Systems Administration Computer Support

Collectively, the nine DP/OUP projects, along with CMSCSI and the HEDP Program, address critical-skills recruiting needs throughout Livermore's SSP and their respective DP campaigns. Historically, the DOE/DP laboratories have been able to draw upon their individual, internal populations to meet SSP workforce needs. However, present estimates indicate a growth—as high as 25%—in the need for SSP employee numbers over the next five years, given certain budgetary assumptions.

As part of a continuing effort to address stockpile stewardship needs, CSIP has quantified the needs within 13 major SSP categories, as jointly created by LLNL and Los Alamos National Laboratory

(Los Alamos) and listed below. When combined, the FY02 projects have the potential to impact all 13 major critical-skills categories, as listed below.

CSIP Internship Projects	Critical-Skills Categories *
Advanced Simulation and Computing Pipeline	HPC
Cyber College Defenders	HPC, ER
High-Energy-Density Physics Program	NDE, P, HPC, DED, IHWEA, UE
Inertial Confinement Fusion Experimental Internships	NDE, P, DED, IHWEA
Interns for Defense Technologies	NDE, EDEW, DED, UE
Internships in Terascale Simulation Technology	HPC, MST, EDEW, M, DED, LPPA
National Ignition Facility Laser Internships	P, MST, DED, LPPA, IHWEA
Nuclear Science Internship Program	NDE, P, HPC, MST, DED, IHWEA, UE, HRFOS, ACNP
Systems Administration Computer Support	HPC

**\*Critical-Skills Category Abbreviations**

ACNP: Arms control and nonproliferation

DED: Dynamic experimentation and diagnostics

EDEW: Engineering design and evaluation for weapons

ER: Emergency response

HPC: High-performance computing and simulation

HRFOS: Hazard-ranked facility operations and security

IHWEA: Inertial confinement fusion/high-energy-density weapons experiments and analysis

LPPA: Laser, pulsed power, accelerators

M: Manufacturing

MST: Materials science and technology

NDE: Nuclear design and evaluation

P: Physics

UE: Underground experimentation

Another approach to critical skills involves campaigns that are multifunctional efforts across the National Nuclear Security Administration (NNSA) DP laboratories, the production plants, and the Nevada Test Site. In aggregate, these campaigns constitute an integrated weapons science and technology program for developing critical capabilities for weapons qualification and certification. The goal of the NNSA/DP campaigns is to address current or future capability needs by employing the best scientists and engineers and by using the most current scientific knowledge and technologies. Many of the campaigns are interrelated and establish a foundation for future deliverables in directed stockpile work. Without a robust campaign program, our ability to support stockpile stewardship would be seriously harmed. With this in mind, similar to the critical-skills categorization, CSIP has categorized the FY03 project proposals (<http://csip.llnl.gov/proposals/FY03/>) by the DP campaigns.

CSIP Intern Projects	DP Campaigns*
Advanced Simulation and Computing Pipeline	4, 6, 14, 18
Cyber College Defenders	13
High-Energy-Density Physics Program	1, 2, 4, 5, 6, 9, 13, 14
Inertial Confinement Fusion Experimental Internships	5, 6, 7, 8, 14
Interns for Defense Technologies	9, 10, 11, 12, 13, 15, 16, 19, 20
Internships in Terascale Simulation Technology	4, 14,
National Ignition Facility Laser Internships	14
Nuclear Science Internship Program	5, 6, 14
Systems Administration Computer Support	14

#### \* DP Campaign List

##### Directed Stockpile Work Campaigns

1. Stockpile maintenance
2. Stockpile evaluation
3. Dismantlement/disposal
4. Stockpile research and development

##### Science Campaigns

5. Primary certification
6. Dynamic materials properties
7. Advanced radiography
8. Secondary certification and nuclear systems margins

##### Engineering Campaigns

9. Enhanced surety
10. Weapons system engineering certification
11. Certification in hostile environments
12. Enhanced surveillance
13. Advanced design and production technologies

##### Advanced Simulation and Computing Campaigns

14. Advanced simulation and modeling

##### Pit Manufacturing Campaigns

15. Pit manufacturing

##### Readiness in Technical Base Facilities Campaigns

16. Operations of facilities
17. Program readiness
18. Special projects and other
19. Material recycle and recovery
20. Containers

As part of the Laboratory's overall recruitment strategy, CSIP student internships will create an additional external pipeline of college and university students who have had direct contact with NNSA science through their on-site research experiences.

CSIP interns are strongly encouraged to provide a Web-based description of their summer experience at <http://internships.llnl.gov/portfolio>, which can be viewed by the entire NNSA complex for future recruiting needs.

CSIP interns are also required to document their summer research by participating in the LLNL Student Research Symposium (<http://step.llnl.gov/symposium>).



CSIP interns and all LLNL summer students are provided with workshops and lectures that describe the Laboratory's mission-based science research, especially research within the Laboratory's national-security mission. Workshop and lecture details can be seen at the STEP-sponsored Student Bulletin Board at <http://step.llnl.gov/sbb>.

Many students entering one internship project find that their interests change during their education and become more aligned with another core discipline and/or specific SSP critical skill. Exposing students to all CSIP NNSA/DP-Education internships allows students to develop a broader understanding of the needs within all SSP-relevant areas at LLNL.

## Advanced Simulation and Computing Pipeline

URL: [http://internships.llnl.gov/asci\\_interns/](http://internships.llnl.gov/asci_interns/)

### Purpose

The purpose of this project is to increase the number of students majoring in computer science, their awareness of Advanced Simulation and Computing (ASCI) opportunities at NNSA/DP laboratories, and the number of students pursuing careers in the new scientific discipline of high-performance, computer-based modeling and simulation.

### Description

Summer students are recruited in the fall and early winter, based on recommendations from computer science faculty and through general recruiting efforts. Applicants complete an electronic interest form available from [http://internships.llnl.gov/asci\\_interns/](http://internships.llnl.gov/asci_interns/). Once the applications are received, they are distributed to key ASCI employees, who review applicants for summer employment and match them to specific projects. ASCI researchers are encouraged to contact applicants to discuss and assess student interests and skills and to identify possible project matches. Once the student and researcher have agreed on a project of mutual interest, the candidate completes an LLNL job application, submits the security-clearance paperwork, and receives a formal job offer.



*One of the ASCI Pipeline students*

During the interim period, researchers are encouraged to maintain contact with the students, refer them to Web sites, and mail them additional information about the projects, so that the students become a part of the research teams even before arriving on-site.

Upon their arrival, students work at the Laboratory for approximately 12 weeks on a variety of different projects within the ASCI Program and Computation Directorate. The ASCI Program ensures that the students have access and exposure to high-level computational science. In addition to the research experience, students are required to participate in the Internships in Terascale Simulation Technology Lecture Series (see [http://education.llnl.gov/itst/itst\\_schedule.html](http://education.llnl.gov/itst/itst_schedule.html)), give oral presentations to peers within their working groups, and summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the student's academic major, LLNL research project, perceived benefits by the participant, and any additional Web resources for more information. (Student portfolios are available at <http://internships.llnl.gov/portfolio/>.) The electronic

portfolios can later be used as references on student resumes. In addition, the portfolios serve as recruitment tools for future students, who may access and review these portfolios when applying to LLNL NNSA/DP projects to obtain additional information.

## NNSA/DP and LLNL Mission Benefits

The ASCI Program is one of the largest DP campaigns, and in the absence of testing, computational design is critical. The Laboratory must continue to provide the ASCI Program with the best computer scientists in the field. Even though many job searchers and recent graduates are focused in information technology, they do not fill the LLNL workforce need for high-performance computing computer scientists and engineers. The workforce shortage addressed by this project is evidenced by the fact that in FY02, within the Computer Science classification in LLNL DP-relevant programs, 47 full-time equivalent (FTE) employees were hired, while 34 job openings remained unfilled. In FY01, the Computation Directorate continued to lose employees. In fact, terminations in FY01 exceeded those in FY00. The increasing number of non-U.S. citizens attending U.S. graduate schools further compounds this projected workforce shortage.



*ASCI Pipeline recruitment poster*

One of the best ways to impact this need is to hire summer interns under the ASCI Pipeline Program and then pique their interest in the following ASCI program elements: high-performance visualization, high-performance computing, advanced computational simulation, high-performance computer administration, computer security, and networking. Student interns at LLNL will thus become part of the Computation Directorate's overall recruiting strategy by forming an external pipeline of college and university students who have had direct contact with NNSA science through their on-site research experiences. Students who are brought into the Laboratory as summer interns will become exposed to all ASCI program elements and will work in a multidisciplinary atmosphere where they meet and work with scientists who are dedicated to the ASCI Program. The Laboratory needs to continue to bring student interns into these areas to be successful in ASCI simulation.

## Partners

### Laboratory

- ASCI Program
- DNT Directorate
- Computation Directorate

### Non-Laboratory

- California State University, Hayward
- Northern Arizona University (NAU)

- University of Utah Center for the Simulation of Accidental Fires
- San Jose State University
- University of the Pacific
- U.S. universities

## Objectives

- Increase the recruitment of ASCI Pipeline participants to 20 student interns (upper-division undergraduate), who are U.S. citizens, on a national scale.
- Fulfill a need for more U.S. citizens who are computer science graduates with backgrounds in the scientific parallel-processing environment to work at LLNL or other DP-managed laboratories.
- Increase the capability, capacity, and quality of candidates with bachelor's degrees in computer science at partnering universities.
- Increase the awareness of graduate opportunities at the first-level ASCI Alliance schools.
- Suggest relevant computer science curriculum (e.g., parallel programming, C++, and Java) to pilot school professors that would enhance student knowledge upon entering the ASCI Program.
- Introduce summer interns to ASCI Alliance Center computing projects and collaborating LLNL scientists.

## FY02 Accomplishments

- Of the 15 summer interns in FY02, all but one asked the ASCI Program to keep their security clearances active in case they wanted to come back as summer interns paid by the program. In addition, various Laboratory programs hired five previous ASCI Pipeline summer interns because of the interns' successful experience. An added benefit was that the summer interns actively recruited other students and encouraged them to apply as ASCI Pipeline interns.
- LLNL recruiters worked with NAU professors to develop appropriate classes to prepare students for LLNL computer science work. Parallel programming classes were developed to teach MPI and OpenMP. The ADA programming language was also taught because the National Ignition Facility (NIF) control system was developed in ADA.
- The ASCI Pipeline technical lecture series ([http://internships.llnl.gov/asci\\_interns/schedule.html](http://internships.llnl.gov/asci_interns/schedule.html)) was enhanced.
- Fifteen participants were recruited in summer 2002; most will be retained as indeterminate employees to support their projects during the school year and will continue to receive salaries.
- Previous ASCI Pipeline students who were hired as summer interns and paid by the ASCI Program continue to be retained as indeterminate employees in the coming school year.

## FY02 Accomplishments *continued*

They will be paid to support their projects, and each student is being positioned for hiring as an FTE after graduation. These students are also being encouraged to attend graduate school at the ASCI Alliance Universities and to become involved with the Alliance Center Program.

- ASCI Alliance Centers participated in the LLNL Student Research Symposium on August 8, 2002, to meet the ASCI Pipeline students and to engage them in conversations about their work. LLNL hosts approximately 400 summer students, and the symposium gives the ASCI Pipeline students an opportunity to present their student research and work during a poster session. This is the optimal time for the ASCI Alliance Center staff to meet and encourage students to participate in ASCI projects and attend graduate school at the universities where the Level One Alliance Centers are located.
- ASCI personnel invited STEP representation in the spring and fall NAU College of Engineering & Technology Employment and Internship Fair, and STEP personnel assisted with the individual interviewing on the second day.

## Evaluation/Assessment

Feedback from FY02 participants continued to indicate that good matches were made between the students and their projects. Students were able to use and expand upon their programming skills. Most, if not all, of the students gained computer knowledge and skills, ranging from Python and advanced UNIX to SGI machine utilization and advanced fluency in C++. Other students learned about programming sockets and building libraries in the Windows environment, while still others learned about parallel computing skills and knowledge and about integrating applications and operating systems.

When participants were asked what makes the LLNL experience unique, typical responses included student access to large-scale parallel computer systems, the many experts in different computer science areas, and more hands-on work that enabled them to apply the theories they were learning in school. One student responded, “I was able to work with leaders in the field. I was also learning and reading about the same topics third-year graduate students were learning.”

Students were asked if the LLNL summer internship had influenced their decision about a career direction. Students generally responded by saying that the internship had excited or strengthened their interest in their future careers or had helped them eliminate what they do not want to do. Some also said that the internship had helped them decide to pursue graduate school.

## College Cyber Defenders

URL: <http://internships.llnl.gov/ccd/>

### Purpose

The College Cyber Defenders (CCD) program is a collaboration between college students of all levels, and computer science and information-security professionals. This collaboration allows students to learn concepts and gain skills in information technologies and protection in a distributed environment (such as the Internet). The Lawrence Livermore CCD program, currently in its first year, is based on the successful Sandia National Laboratories, Livermore, (Sandia, California) CCD program. This program is vital for producing computer-security professionals at all levels for the DOE/DP laboratories and other government sectors. The CCD program provides students with the necessary skills, as well as a positive experience at a DOE/DP laboratory that should positively influence their decisions to join as career employees after graduation.

During the program, students are required to participate in the CCD Lecture Series. The lectures are also open to other summer students and are coordinated with the Sandia, California, CCD program. Additionally, CCD students give oral presentations to peers within their working group. They are also encouraged to contribute posters to the LLNL Student Research Symposium and to summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the student's academic major, Laboratory research project, perceived benefits by the participant, and



*The three LLNL College Cyber Defenders students in FY02*

any additional Web links for more information. (Student portfolios are available at <http://internships.llnl.gov/portfolio/>.) Electronic portfolios can be used as references on resumes and become recruitment tools for future students, who may access and review these portfolios when applying to NNSA/DP projects at the Laboratory.

## Description

CSIP personnel and the program's principal investigators will spend the second year expanding the CCD program at the Laboratory to include up to eight full-time summer interns. More emphasis will be placed on recruiting from local schools, as the program was unable to attract any qualified applicants from local schools during the first year. These local students will stay on as part-time interns during the following school year. Most of FY03 will be spent expanding the program, strengthening programmatic ties at LLNL, and furthering relationships with the CCD program at Sandia, California; UC Davis; and other colleges and universities.

In this second year, the CCD program at LLNL will focus on building upon the information infrastructure put in place during the first year of the program and expanding the base of student projects. Along with this infrastructure expansion, the new projects will provide a basis from which the students will learn and practice the skills gained from the CCD program. Up to eight students will participate in the CCD program in FY03. Most likely, these students will all start the program at the beginning of summer for a 12-week term. Any returning students who are available in the spring term may begin working then in preparation for other returning students. As many as half of the returning students will continue on at the end of summer to work part-time during the 2003–2004 school year.

It is hoped that some of the FY02 students will return to help guide the new students in the process of expanding the Lawrence Livermore CCD infrastructure (such as the personal computers and networks). Furthermore, the CCD program expects that the students will be able to spend some time with their counterparts at Sandia, California, to observe their program, especially their infrastructure. In the process of building the LLNL infrastructure, each of the students will be expected to be able to

- build and configure personal computers,
- connect a personal computer to a public network, such as the Internet,
- connect a personal computer to a private network, such as the internal CCD network,
- participate in the process of protecting both their machines and the network as a whole from internal and external threats, and
- understand risk assessment and the decision process used when developing and implementing a security plan.



*College Cyber Defenders recruitment poster*

Additionally, each student will be given exposure to the following areas:

- Analyzing and understanding malicious computer code, including exploits, worms, viruses, and Trojan horses
- Analyzing system and network logs to recognize malicious activity
- Forensic analysis on a compromised system to reconstruct how it was compromised and what activity the intruders performed once inside
- Vulnerability assessment to determine in what ways a system or network could potentially be compromised and how those weak points can be reinforced

## NNSA/DP and LLNL Mission Benefits

It is extremely difficult to attract people who are knowledgeable in information technology and computer security to LLNL and the rest of the DOE complex, primarily because information security is still a growing field, and very few universities are training students to be proficient in this area. In fact, the number of trained students steadily decreases with increasing educational level. A paper by Eugene Spafford (available at <http://www.aaas.org/spp/yearbook/2003/yrbk03.htm>) provides some hard numbers about the low rate of information-security graduates. Spafford notes that of the seven information-security Ph.D.s in the United States each year, two or three return to their home countries, and about three accept academic positions. The remaining graduates—who may not be U.S. citizens—can choose between government service and high-paying industry jobs.

Although the numbers are greater further down the educational ladder, industry remains a viable option for highly qualified candidates, even during the current economic downturn. The CCD program is intended to address this problem by directly providing both training and experience in numerous aspects of information technology and protection within the HPC and ER critical-skills categories (see page 9). The positive and synergistic environment in which the training and experience are provided should encourage students to join LLNL or another DOE complex after graduation.

## Partners

The CCD project at LLNL will build on the Laboratory's world-class expertise in computer and information security, such as the Information Operations Assessment Center, as well as the experience of Livermore Computing in protecting the world's most powerful supercomputing resources. These organizations will assume the cost for the facilities to house program participants, including furniture, equipment, and infrastructure such as network connections and phones. These organizations will also fund regular information-technology seminars and the time for program advisors. This higher funding level represents a significant increase in the leverage ratio with DP-Education funding over last year, representing a greater acknowledgement by LLNL programs of CCD's value.

CCD also continues to partner closely with the existing Sandia, California, CCD program on activities such as weekly seminars and joint exercises.

## Objectives

- Provide community college to graduate students with training and practical experience in information technology and security.

- Allow students to build their professional skill sets by having them work in groups, perform cost/benefit analyses, author papers, and give presentations.
- Create potential DP laboratory FTEs who are versed in many different aspects of information technology and computer security.
- Establish a good impression with students so that they will be motivated to apply for full-time positions within DP laboratories after graduation.
- Increase student interest in information security so that they will pursue higher levels of education in this area (e.g., community college students attending four-year institutions and undergraduates pursuing graduate degrees).
- Provide an environment for graduate students to conduct thesis research in information security.
- Develop a partnership with Sandia, California, to further the development of the CCD program at all sites.
- Develop a partnership with UC Davis and other universities as strategic colleagues in the program.

## FY02 Accomplishments

- Three students were attracted for the summer FY02 term.
- Students worked as a single group, building infrastructure and conducting research in network intrusion detection.
- Students created a program to convert Snort (a popular, open-source network intrusion detection system) signatures into the Network Intrusion Detector (NID) format.
- Through conversion from Snort and exploit code analysis, students developed about 1,000 NID signatures. The addition of these signatures provides significant added value to the NID project and its users within both DOE and throughout the federal government.
- The Intrusion Detection Exchange Server was ported to work with the Apache Web server. It is expected that this server will be placed in operation for NID users within both DOE and throughout the federal government sometime in early FY03.
- Students presented their work to peers, visitors, programmatic management, as well as at the LLNL Student Research Symposium.
- A weekly seminar series was held that covered numerous aspects of computer security, thereby providing exposure to the four core areas of information security.
- The group is evaluating if any of the results found in the CCD program are worthy of publication.

## FY02 Accomplishments *continued*

- A CCD participant who is a college senior is currently looking for an FTE position in computer security for a DP laboratory. (Unfortunately, LLNL does not have any entry-level computer-security positions at this time.)
- The LLNL CCD program has collaborated with the CCD program at Sandia, California, by adopting its diode and FlexNet technologies.
- The CCD program has established a presence at UC Davis. (UC Davis students have mostly participated in the Sandia, California, program.)

## Evaluation/Assessment

A single term should give a student sufficient time to learn to perform tasks in at least one of the final four areas (given the technical depth and complexity of each of those areas). After numerous terms in the program, each student will be expected to be able to perform tasks in all four areas.

Each student will also be expected to participate in research. This research may touch on any aspect of data protection and computer security, such as cryptography, trusted systems, risks in new technologies (such as Windows XP, wireless networks, etc.), security knowledge management, or protection systems and controls. The scope of this research will range from surveys and best-practice analyses to new research on open problems, depending on each student's skill level.

The CCD program can be evaluated at three levels. The first of these is a subjective evaluation based on interest in the program by Laboratory organizations, colleges and universities, government, and the media. In its first year, personnel at all levels have continued to express much interest in the LLNL CCD program and have graciously spared their time to conduct student seminars. Some media interest is anticipated in the LLNL CCD program and its various research projects. Media coverage of the Sandia, California, program may also include information about the LLNL program as an illustration of how the Sandia, California, program has grown.

The second level of evaluation involves student accomplishments. In particular, did each participant succeed in learning the fundamental skills, become exposed to all four listed areas, and conduct research in information security?

The final, and perhaps most important, evaluation of the program is if it can produce full-time employees for LLNL, the DP laboratories, or other parts of government who are well-versed in information technology and security. Alternatively, do the participants in the program choose to pursue higher levels of education in information technology and security? One of the FY02 students is expected to graduate in FY03, so at least one data point can be collected for this evaluation in FY03.

## Computational Materials Science and Chemistry Summer Institute

URL: <http://internships.llnl.gov/mri/>

### Purpose

The purpose of the Computational Materials Science and Chemistry Summer Institute (CMSCSI) is to provide an opportunity for graduate students to explore and learn some of the cutting-edge methods in computational materials science, computational chemistry, and other related areas of computational science that are of relevance to Laboratory programs. Each student spends eight weeks at Livermore as the guest of an LLNL host scientist, working on a computational project in the host's area of expertise. In addition, the students take short courses presented by leading professors and scientists that cover state-of-the-art and emerging computational methods and practical aspects of their numerical implementation.

Over the past several years, Laboratory scientists have developed unique mathematical algorithms and computer codes intended to make the best use of the unmatched capabilities of massively parallel terascale computing that has been established at LLNL. These new capabilities make it possible to model material properties and behaviors with unmatched realistic complexity, using predictive computer models. This new paradigm has created a great deal of excitement in the computational science community. At the same time, it presents new scientific challenges and calls for new computational approaches that are the focus of CMSCSI. The Institute is intended to provide an early exposure to the emerging ideas and inner workings of computational materials sciences and computational chemistry relevant to LLNL. CMSCSI also hopes to unleash the creative potential of future leaders.

CMSCSI has now run for two years with sponsorship from multiple NNSA programs within LLNL. The Materials Research Institute (<http://www-cms.llnl.gov/MRI/>) has demonstrated an ability to build strong collaborations between LLNL and university researchers and is now ready to expand CMSCSI significantly to meet the requests of LLNL scientist mentors who wish to participate in this program.

### Description

During the FY01 and FY02 programs, CMSCSI students were collocated with the researchers of the LLNL MRI and attended a series of lectures at the Livermore site of the UC Davis DAS. The lectures, intermediate-level talks on theoretical and computational methods in materials science and chemistry, were presented by Laboratory staff members and professors with a close LLNL association via ASCI. The lectures were promoted through the neighboring large universities (e.g., Stanford, UC Berkeley, and UC Davis) and were held at DAS in order to allow attendance by the public. Some people from other government laboratories also attended.

The student level for the Institute was selected as the first or second year of graduate school. Informal polls of the students found that the summer course level aligned well with their graduate school courses.

## NNSA/DP and LLNL Mission Benefits

The objectives of the CMSCSI effort are directly aligned with the NNSA/DP campaigns in support of SSP. Specifically, by attracting and training junior scientists in the critical-skills areas of materials science and chemistry, CMSCSI provides linkage between and contributes to several NNSA/DP campaigns. Specific examples include the following:

### ***Primary and Secondary Certification Campaigns***

Computational materials science and chemistry are key critical skills in support of the Primary and Secondary Certification Campaigns. In particular, the development of computational capabilities to predict the properties and response of materials under extreme conditions is at the heart of evaluating weapons performance. Stockpile certification is ensured by expert judgment informed by advanced computational tools and experimental validation. Predictive materials models and validated materials properties form the scientific underpinning of simulation tools used for stockpile certification. Consequently, the CMSCSI education program directly supports the Primary and Secondary Certification Campaigns by training students in critical skills, such as computational materials science and chemistry.

### ***Dynamic Materials Properties Campaign***

The objective of the Dynamic Materials Properties Campaign is to provide science-based and experimentally validated models of the dynamic response of materials under conditions of pressure, temperature, strain, and strain rates of relevance to nuclear explosions. In addition to the confines of dynamic materials properties, this campaign also supports efforts in physical data research, including fundamental materials properties (equations of state, constitutive properties, mechanical response, etc.), the chemistry of high explosives and energetic materials, materials aging, and materials processing and synthesis. Consequently, the CMSCSI education program directly supports the Dynamic Materials Properties Campaign through training in the field of computational materials science and chemistry.

### ***Advanced Simulation and Computing Campaign***

A key objective of the Advanced Simulation and Computing (ASC) Campaign is the development of 3-D high-fidelity, end-to-end, full-system simulations. A key element of the ASC Campaign is developing computational science-based materials models to predict the response of materials under dynamic conditions. Specifically, the ASC Campaign embodies a major program element in the area of materials and physics modeling. Inherently, CMSCSI directly supports the ASC Campaign by training next-generation leaders in the field of computational materials science, with a particular emphasis on the development of science-based models of the physics and chemistry of materials.

In addition to its relevance to the Livermore DP campaigns, student interns at LLNL will be part of the overall recruiting strategy to help create an additional external pipeline of college and university students who have had direct contact with NNSA science through their on-site research experiences.

## Partners

- The CMSCSI program is a partnership between the summer intern program, students, and postdocs within the Chemistry and Materials Science (CMS), Physics and Advanced Technologies (PAT), and Engineering directorates and CSIP's overall student internship opportunities within the LLNL national-security program.

## Objectives

- Recruitment of scientists within the LLNL SSP directorates.
- Given the successes of the first two years, CMSCSI is being recommended for FY03 DP-Education funding to increase the number of Institute-funded students from 8 to 30.
- A dedicated recruiting Web site (<http://internships.llnl.gov/mri>) will be improved to allow an initial applicant review process by CSIP, followed by a thorough review of all applicants by the principal investigators to determine the best research connection for each student.

## FY01 and FY02 Accomplishments

- CMSCSI took place from June 18 to August 10, 2001, and from June 19 to August 13, 2002. In the first year, eight summer students were selected from a pool of applicants who demonstrated a strong interest in computational sciences. In the second year, 11 graduate students were selected, including 8 students who were funded by the Institute.
- CMSCSI was a pilot project during FY01 and FY02 supported by DP line funding only. CSIP's involvement included creating Web-based recruiting materials and providing advice and help in the overall startup of the project.
- At least two of the FY01 students and at least seven of the FY02 students will continue to work on Ph.D. thesis projects with their Institute hosts.
- Most of the students will complete the projects that they started in order to publish papers.
- This project gave several top students, early in their graduate careers, the opportunity to see what kinds of skills and capabilities exist at Livermore and other DP laboratories and the strong collaborations between top university researchers and LLNL scientists.
- MRI is ready to expand CMSCSI to include more students.

## Evaluation/Assessment

A great deal of camaraderie was established among the students. They worked on their projects together and took weekend trips together. MRI held a weekly brown-bag lunch that was well attended by students and their Laboratory hosts. In early August of the first year, the fellows were also invited to attend the LLNL simulations workshop. During both years of the program, evaluation of the students' research was determined in part by their participation in the LLNL Student Research Symposium. The student posters were of very high quality.

## High-Energy-Density Physics Program

URL: [http://internships.llnl.gov/hed\\_physics/](http://internships.llnl.gov/hed_physics/) and  
<http://www.llnl.gov/adiv/HEDPSS/>

### Purpose

The purpose of the High-Energy-Density Physics (HEDP) Program is to prepare graduate and undergraduate students, who are U.S. citizens, for experimental, theoretical, and computational research in astrophysics, hydrodynamics, turbulence, plasma physics, and radiation/particle transport as applied to the evolution of complex systems.

Students chosen to be HEDP interns are assigned research mentors within A and X Divisions, within the DNT Directorate. A Division maintains an extensive collection of Web site material (<http://www.llnl.gov/adiv/>) that describes research topics, facilities, and employment opportunities.

In addition to summer-student internships, internships during the academic year for undergraduate thesis research, graduate completion of master's degrees, and doctoral thesis research are available for truly outstanding candidates.

### Description

As in the pilot year (FY01), recruitment materials for the HEDP Program, including a color poster, were sent to all 800 U.S. physics departments accredited by the American Institute of Physics.

A dedicated recruiting Web site ([http://internships.llnl.gov/hed\\_physics](http://internships.llnl.gov/hed_physics)) provided an initial vehicle through which applicants could apply. A thorough review of all applicants by the HEDP Program principal investigator determined the students best suited for HEDP internships.

The HEDP student recruiting Web site also contains links to other critical-skills student internships, LLNL summer-employment opportunities, and the three NNSA/DP laboratories and their respective SSP internship opportunities. A single point of contact, a program administrator, is assigned to help student interns with all administrative issues, including hiring, security clearances, etc.

### NNSA/DP and LLNL Mission Benefits

The primary mission of the DNT Directorate is to ensure national and global security by maintaining scientific and technical competence and leadership, in the absence of nuclear testing, in all aspects of thermonuclear weapon physics, design, and operation. This involves the application of theoretical, computational, and experimental physics to a wide range of topics relevant to national defense and security.

### Partners

#### *Laboratory*

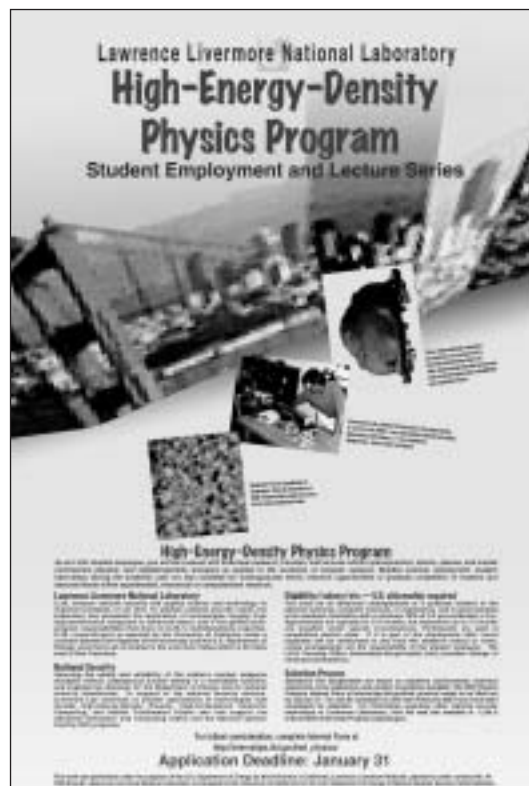
- A and X Divisions, DNT Directorate
- PAT Directorate
- LLNL National Security Program

### Non-Laboratory

- The American Institute of Physics
- Accredited U.S. Physics Departments

### Objectives

- Scientists will be recruited to the DNT Directorate, with an emphasis on A and X Divisions.
- A and X Divisions will employ up to 20 student interns (graduate and upper-division undergraduate students) per year in this program.
- Each of the five major research areas (astrophysics, hydrodynamics, turbulence, plasma physics, and radiation/particle transport) will have a Laboratory researcher who will serve as the primary contact for answering initial student inquiries regarding internship possibilities.
- Each student's LLNL mentor will be chosen by HEDP Program principal investigators to match both the student's and mentor's research interests to maximize future collaborations with the student's college or university and faculty advisor.
- Collaborations with academia will be modeled after the successful ASCI Alliance strategy.
- Student interns will be strongly encouraged to publish by providing a staff of artists and editors from A and X Divisions to facilitate the publication process for both papers and abstracts.



*High-Energy-Density Physics Program  
recruitment poster*

### FY02 Accomplishments

- In its second year with Laboratory DNT funding only, the HEDP Program had 14 undergraduate participants, compared to 17 in FY01. The FY02 number was lower than in FY01, in part due to the difficulty in finding appropriate projects and mentors for the students. To alleviate this problem in FY03, the start date for reviewing the student applicants has been moved up from March to February.
- Six of the 14 summer interns presented their research results in November 2002 at the annual meeting of the American Physics Society Division of Plasma Physics in Orlando, Florida.

## FY02 Accomplishments *continued*

- In part due to the success of the FY01 and FY02 HEDP Programs, LLNL recently conducted a summer school to present a broad overview of HEDP topics. The summer school was aimed at advanced graduate students, postdoctoral researchers, and staff researchers new to the field.

## High-Energy-Density Physics Summer School

The 2002 HEDP Summer School (HEDPSS) (<http://www.llnl.gov/adiv/HEDPSS/>) took place from August 4 through 16 at UC Santa Cruz and was cosponsored by the Hertz Foundation and the UC Santa Cruz Department of Astronomy and Astrophysics.

A and X Divisions at LLNL led the coordination for the overall HEDPSS program, and the summer school was financially supported by several key Laboratory directorates, including DNT, PAT, CMS, NIF, and the University Relations Program.

The main goals of the HEDPSS were to

- identify and interact with top graduate students and postdocs from around the world who will be entering the HEDP workforce in the near future,
- network with postdoctoral researchers and faculty members and identify possible future research and development (R&D) collaborations, and
- serve as a training ground for the Laboratory's recent recruits and other researchers entering the HEDP field.

The technical program of the HEDPSS centered on key areas of Laboratory expertise and the Laboratory's programmatic mission. Covered topics included radiation transport and spectroscopy, hydrodynamics, laser-plasma interactions, and the measurement and use of associated materials properties. The technical agenda consisted of plenary lectures from leading experts in the field and also included detailed poster and invited presentations about ongoing research activities in HEDP. There was also a one-day site tour of LLNL on Monday, August 12.

HEDPSS attendees included 50 graduate students, 21 postdoctoral researchers, and 13 staff members. Attendees came from major universities around the world and national laboratories including LLNL, Sandia, Los Alamos, and the Atomic Weapons Establishment from the United Kingdom.

A total of 54 staff members from LLNL, Los Alamos, Sandia, and the University of Chicago (the ASCI Alliance Center for Astrophysical Thermonuclear Flashes) gave plenary, invited, and poster presentations at the summer school.

## Evaluation/Assessment

Given the success of the FY01 and FY02 HEDP Programs, DNT management has decided to continue the internship program in FY03 with programmatic funding. All 14 of the FY02 students are being targeted for potential FY03 internships. Additional students are being recruited through the HEDP Program Web site ([http://internships.llnl.gov/hed\\_physics](http://internships.llnl.gov/hed_physics)).

The 2002 HEDPSS (<http://www.llnl.gov/adiv/HEDPSS/>) at UC Santa Cruz served as a pilot program. Based on returned surveys and immediate feedback, the program was well-received. Of the returned surveys, 98% indicated that the overall program was either excellent or good. A key long-term indicator of HEDPSS's success will be the number of attendees who apply for positions at the national laboratories to work in HEDP.

## Inertial Confinement Fusion Experimental Internships

URL: <http://internships.llnl.gov/icfei/>

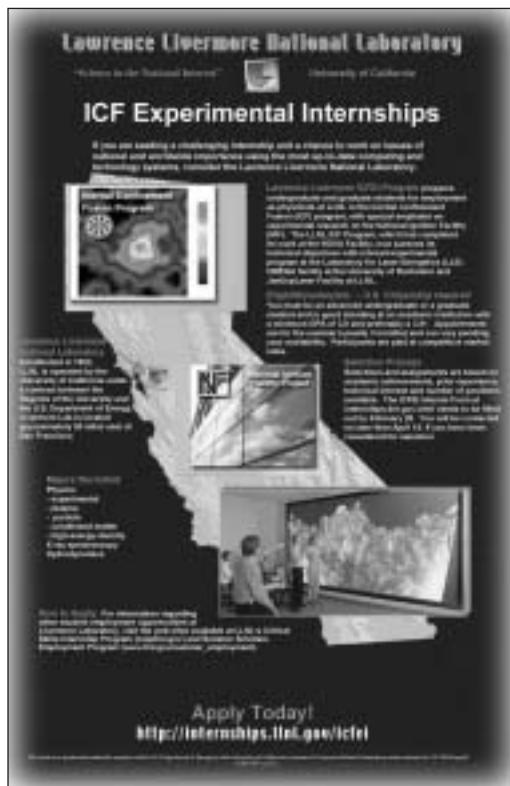
### Purpose

The Inertial Confinement Fusion Experimental Internships (ICFEI) prepare advanced undergraduate and graduate students for employment as physicists at LLNL in the Inertial Confinement Fusion (ICF) Program, with a special emphasis on NIF experimental research. The LLNL ICF Program, which has completed its work at the Nova facility, now pursues its technical objectives with a broad experimental program at the Laboratory for Laser Energetics (LLE) Omega facility at the University of Rochester and at the JanUSP laser facility at LLNL. This ongoing effort is focused on ICF target physics research and diagnostic development, in preparation for the NIF experimental program at the Laboratory. ICFEI will establish a valuable resource that prepares young physicists and introduces them to the ICF Program at LLNL by supporting student research and thesis projects that contribute to ICF experiments.

### Description

ICFEI-funded students will develop and field advanced target diagnostics at the University of Rochester's Omega and the LLNL JanUSP facilities—both of which are used for ICF research. These diagnostics will be designed as prototypes for diagnostics on NIF target experiments. This area offers a variety of research topics in x-ray and particle physics, nuclear physics, atomic spectroscopy, and x-ray optics. Special emphasis will be placed on spectrally resolved x-ray imaging, neutron imaging, and neutron spectroscopy for application to implosion core diagnosis.

ICFEI-funded graduate students will also perform research in laser-plasma interaction physics at the Janus facility at LLNL, the Trident facility at Los Alamos, and the Omega facility at the University of Rochester. In addition to providing a wealth of basic-science studies, this area of research is important for understanding and optimizing the coupling of laser light into NIF ICF and high-energy-density science targets. Several high-quality students have been attracted to and have graduated in this area within the ICF Program. Recruitment will primarily be conducted through individual discussions with professors and staff scientists at targeted universities.



*Inertial Confinement Fusion Experimental Internships recruitment poster*

### NNSA/DP and LLNL Mission Benefits

Recent years have seen a decline in the number of students and young physicists in the ICF Program, and

the internship program provides a means to reverse this trend. The success of the ICF Program is key to the success of NIF in meeting its DP mission and goals. Preliminary NIF experiments will begin in less than two years, and identified NIF goals require that the experimental element of the ICF Program double in size over the next five years. With a typical duration of 3–5 years for a first- or second-year graduate student to complete their Ph.D. requirements, now is the time to provide expanded opportunities for these students. Previous efforts of this kind already have brought one postdoctoral physicist from the Massachusetts Institute of Technology (MIT) to LLNL. The ICFEI will expand on this success and help to ensure the availability of high-quality physicists for ICF and DP.

## Partners

- Partners at LLNL include the PAT Directorate, especially physicists Mike Moran, N Division, and Ronnie Shepherd, V Division.
- Partners outside LLNL include Ed Morse, UC Berkeley; Richard Petrasso, MIT; Roberto Mancini, the University of Nevada at Reno (UNR); Chand Joshi, University of California Los Angeles (UCLA); Steve Padalino, State University of New York (SUNY), Geneseo; and the ICF researchers at the University of Rochester LLE.
- Adding ICFEI to NNSA/DP-Education provides an essential partnership between LLNL's summer intern program, NIF students and postdocs, and CSIP's overall student internship opportunities within the Laboratory's national-security program. Many students entering one internship project find that their interests are ultimately more aligned with another core discipline and/or specific SSP critical skill. Exposing students to all other NNSA/DP-Education interns allows for a broader understanding of SSP activities at LLNL.

## Objectives

- ICFEI will recruit scientists into the Laboratory's SSP, including directed stockpile work and campaigns.
- ICFEI will fund qualified university students who are associated with ongoing ICF collaborations between LLNL and the following universities: MIT, UC Berkeley, UCLA, and SUNY-Geneseo. Informal collaborations also exist with other universities, such as UNR.
- LLNL ICF line funds will directly support a graduate student and a postdoc and will provide partial support for several staff scientists at MIT, within an existing DP-funded collaboration at the LLE Omega facility.
- LLNL ICF line funds will continue to provide partial support for a graduate student at UC Davis, three undergraduate students at University of the Pacific who are performing intern work at Livermore, and a summer undergraduate student from UC Berkeley.
- LLNL/DP-Education will fund two additional graduate students at MIT. These students will become graduate-student employees of LLNL and will spend the academic year at MIT and their summers at Livermore and/or the Omega laser facility.

- LLNL/DP-Education will fund up to six additional qualified graduate students at MIT, UC Berkeley, UC Davis, UCLA, SUNY-Geneseo, and UNR for thesis research relevant to ICF experiments. These students will be summer-student employees at Livermore, Janus, Trident, and/or the Omega laser facility.
- LLNL/DP-Education will fund up to two undergraduate students from the same campuses to explore building additional graduate-student interest in conducting thesis research at the Laboratory on ICF topics.

## FY02 Accomplishments

- Supported the studies of two MIT graduate students under Prof. Richard Petrasso. These first-year students will work on the particle diagnosis of ICF plasmas.
- Brought the MIT students to Livermore for one week during the summer, where they were given an opportunity to meet ICF staff and tour various facilities, including NIF.
- Supported several undergraduate students at SUNY-Geneseo through the support of Prof. Steve Padalino's program and oversaw their work to install and test a large neutron detector at the University of Rochester LLE. (The detector was originally used on the LLNL Nova laser facility before being shipped to LLE.)
- Supported one graduate student (Jason Knight) at UC Davis. Provided mentoring and guidance on researching the laser-plasma interaction field in anticipation of FY03 experiments.
- Supported postdoctoral research at MIT under Prof. Richard Petrasso on the development of advanced charged particle detectors for implementation at the Omega facility. Supported the participation of an MIT research associate on LLNL Omega shots studying proton stopping as a measure of indirectly driven compressed-shell areal densities.

## Evaluation/Assessment

Evaluations will include student and advisor feedback, personal meetings, questionnaires, seminar discussion groups, and student productivity.

## Interns for Defense Technologies

(Previously known as Graduate Interns for Defense Technologies)

URL: <http://internships.llnl.gov/idt/>

### Purpose

The purpose of Interns for Defense Technologies (IDT) is to prepare undergraduate and graduate students—who are U.S. citizens—in nuclear, mechanical, electrical, and materials engineering with research opportunities that contribute to their completion of undergraduate, master's, and doctoral degrees. Upon completion of their 12-week internships, the best of these students will be recruited for employment in the Defense Technologies Engineering Division (DTED) to work on DOE/DP projects. DTED has two roles at LLNL. It is a programmatic organization in the DNT Directorate that is responsible for ensuring the integrity and reliability of LLNL-designed nuclear weapons throughout their stockpile life. DTED also serves as a mechanical engineering division, primarily supporting the SSP.

### Description

DTED and CSIP collaborate with university academic advisors to identify qualified undergraduate, master's, and doctoral students to participate in IDT. Other sources include summer employment and CSIP applicants, and referrals from employee contacts. Each applicant submits an electronic interest form that is available at <http://internships.llnl.gov/idt>. Once submitted, the form is distributed to key IDT researchers, who review the applicants for summer employment and match students to projects. IDT researchers are encouraged to contact applicants to discuss the students' interests and skills, and assess their interest and possible assignment with identified projects. Once the student and researcher have agreed on a project of mutual interest, a formal application can be completed and submitted for a security clearance and a formal job offer. When applicable, the faculty advisor may arrange for the student to receive academic units for advanced laboratory or thesis research throughout the internship.

During the interim period, researchers are encouraged to maintain contact with the students, refer them to Web sites, and mail them additional information on the projects so that the students become part of research teams even before arriving at the Laboratory.

Upon their arrival, students work at the Laboratory for approximately 12 weeks on their DTED projects. In addition to the research experience, students are



*Interns for Defense Technologies recruitment poster*



*One of the FY02 students in the Interns for Defense Technologies program*

required to give oral presentations to peers within their working groups and summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the student's academic major, the LLNL research project, perceived benefits by the participant, and any additional Web links for more information. (Student portfolios are available at <http://internships.llnl.gov/portfolio/>.) The electronic portfolios can be used as references on resumes; the portfolios can also serve as recruitment tools for future students who may wish to apply to NNSA/DP projects.

## NNSA/DP and LLNL Mission Benefits

DTED currently has 23 FTE openings. The opportunity to offer a program like IDT is invaluable both in generating a pipeline of potential future employees and in connecting and strengthening possible collaborations with academia. The IDT program provides multiple benefits to the Engineering Directorate and to SSP. First, through the recruitment process, Laboratory and SSP management are in contact with academic professors and department chairs. As a result, both students and faculty gain direct exposure to the science and technology underpinning the LLNL SSP and DP, which would not otherwise occur. Second, SSP management and researchers must maintain their connections with universities to retain access to the most comprehensive and up-to-date advances in technologies.

Third, because of employee retirements, the predicted workforce shortage, and employee turnover, NNSA and the DOE/DP laboratories must develop the next generation of SSP researchers and managers to accomplish the national-security mission. (The estimated number of retirements in FY03 includes 10 in the scientist/engineer series and 10 in the technical series, with a similar

number expected in FY04.) However, the divisions and departments tasked with stockpile stewardship have been focused on achieving the mission and have not developed a vehicle to identify the next generation of critical-skills workers. Having a science-education program with leveraged funds legitimizes the activity of working with students to develop this pipeline.

IDT is part of the W Program recruiting strategy in support of DP campaigns with experimental activities that have needs for scientists and engineers in the following fields, which lack U.S. citizen university graduates:

- hardware design engineers,
- measurement engineers,
- testing engineers,
- materials analysts, and
- structural mechanics analysts.

Without adequate funding, the ability of the United States to maintain the viability of the nuclear stockpile may be compromised.

## Partners

Partners within LLNL include management and researchers from W Program and the Engineering Directorate. Externally, partners include academic universities across the nation.

## Objectives

- Increase the recruitment of IDT participants from 11 in FY02 to 15 in FY03.
- Include both undergraduate- and graduate-level students who are U.S. citizens.
- Make offers of employment to students participating in the internship project to work at LLNL or DP-managed laboratories.
- Strengthen and expand relationships with academic faculty, identify senior-thesis projects, increase awareness of IDT, and meet future workforce needs related to stockpile-stewardship critical skills.

## FY02 Accomplishments

- Involved a total of 11 program participants in FY02.
- Increased the DP line to DP-Education funding ratio to approximately 2:1.
- Influenced the hiring of three interns as employees within the Engineering Directorate.

## Evaluation/Assessment

Evaluations are ongoing. Program success is measured by program growth through the placement of IDT students in support of projects, the number of students retained in indeterminate status for

future employment possibilities, and the primary objective—the hiring of interns as LLNL employees. As a result of the hires from the past two summers (there were three direct hires of IDT interns in FY01), IDT has been integrated into the overall recruitment strategy of the Engineering Directorate’s workforce support for the Laboratory’s SSP.

Additional assessment input indicates that the majority of participants learn of LLNL internship opportunities through campus visits by Laboratory recruiters, career fairs, and faculty advice. While some students come to Livermore to experience the West Coast environment, most take part in the internship because of their interest in research performed at the Laboratory.

Regarding specific research, most participants are surprised at the level of responsibility, minimal supervision, and the available resources—including a private office. Feedback on supervisors ranged from outstanding, very patient, and supportive to “they are world-class guys!” When students were asked what skills they had gained from the experience, many identified software skills in C, C++, Unix MPI, MathCAD, and ProDesktop. As with other CSIP programs, IDT students commented on the uniqueness of the LLNL internship, which included opportunities to perform cutting-edge research and learn about topics not discussed in the classroom. Students also were impressed with their access to LLNL resources and facilities and the range of projects, from microscale to macroscale.

## Internships in Terascale Simulation Technology

URL: <http://internships.llnl.gov/itst/>

### Purpose

Internships in Terascale Simulation Technology (ITST) prepare graduate and advanced undergraduate students for employment as computational scientists. ITST provides summer students with hands-on experience in the laboratory environment for one or more summers and encourages and equips students to develop backgrounds in terascale simulation. Student internships also permit LLNL to better evaluate the potential of future career hires. This project gives students experience using massively parallel processing systems, mentoring from expert computational scientists, and specialized enrichment instruction in computational mathematics and scientific-visualization techniques. The mentors and instructors are Livermore Computing staff, special guests, and prominent Institute for Terascale Simulation (ITS) scientists. This instruction includes topics not generally available in university curricula, centered on the interdisciplinary approaches (mathematics/computer science/engineering) necessary to work with terascale parallel processing machines. Participation in this instruction is open to all LLNL and neighboring Sandia, California, scientists.

### Description

The research mission of the ASCI-ITS requires computational scientists to have knowledge of the physical applications used in ASCI, computational mathematics, and computer science. This proposal offers six representative research topics:

#### *ASCI Applications*

1. **Simulation of transport:** Modeling of time-dependent and steady-state transport of radiation in complex media.
2. **Simulation of lasers and plasmas:** Modeling of time-dependent phenomena involving lasers, plasmas, and laser-plasma interactions in devices of interest to NNSA.

#### *Computational Mathematics*

3. **Adaptive mesh refinement for partial differential equations:** A simulation methodology that provides both spatial and temporal refinement to focus computational resources in portions of the computational domain to maximize accuracy for given resources of time and memory.
4. **Scalable methods for coupled nonlinear systems:** Scalable algorithms and implementations for solving nonlinear differential equations discretized on 3-D meshes having upwards of one billion spatial zones, including multilevel and Newton-Krylov techniques.

#### *Computer Science*

5. **Exploration of terascale data sets:** Algorithmic techniques and software tools enabling the effective use of the terabytes of data generated by applications running on the ASCI platforms.
6. **Parallel programming paradigms:** Tools and procedures for easing the development process and enhancing the performance of large-scale scientific applications.



*Internships in Terascale Simulation Technology recruitment poster*

All six proposed topics can be supported by ITST students, or the number of topics supported by ITST students can be scaled to best match immediate DP mission needs. Up to six students may participate in each topic area. Participant skills ultimately determine the support provided to any given project. Participants are recruited in the fall and early winter. Laboratory employees visiting students and faculty on campus, as well as recurring visits by students to LLNL, are key to the ITST recruiting strategy. Because targeted applicants include Ph.D. students, long-term investments are required to build relationships with likely advisors.

The ITST students, whether graduate or advanced undergraduate, are employed in technical research capacities that are relevant to stockpile stewardship. Student applicants are chosen from ASCI Alliance academic institutions, the CSIP and summer applicant pool, and individual referrals and contacts. Once chosen, interns are integrated into research teams and assigned mentors.

Students are required to participate in the ITST Lecture Series, which provides students with a common curriculum ([http://internships.llnl.gov/itst/itst\\_schedule.html](http://internships.llnl.gov/itst/itst_schedule.html)), and to give oral presentations to peers within their working groups. Interns are also

encouraged to contribute posters to the LLNL Student Research Symposium (<http://internships.llnl.gov/symposium/>) to summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the student's academic major, the LLNL research project, perceived benefits by the participant, and any additional Web links for more information. (Student portfolios are available at <http://internships.llnl.gov/portfolio/>.) The electronic portfolios can be used as references on resumes and become recruitment tools for future potential student applicants to access when reviewing NNSA/DP projects at the Laboratory.

## NNSA/DP and LLNL Mission Benefits

LLNL needs to prepare now to address major workforce changes that will occur over the next ten years. As one key example, the DNT Computing Applications (DCOM) Division within the Computation Directorate supplies computational and computer scientists that support two DP campaigns: Stockpile Research and Development and Advanced Simulation and Modeling. There are presently 69 career staff and 2 retirees supporting DCOM. Within five years, 18 of them (26%) are expected to retire. Another eight (12%) are expected to retire in ten years. While attrition is not a major issue at this time (due to the current economy), past history shows that an additional 5% yearly loss due to attractive offers from industry can be expected once the economy improves. These positions will need to be replaced by trained computational scientists (especially at the M.S. and Ph.D. levels). Unfortunately, U.S. schools are producing too few computational scientists today. Within the traditional academic discipline of computer science, most students are being

trained for careers in industry. These students often receive minimal exposure to the high-end scientific computing (computational physics, computational modeling, etc.) needed for the future workforce at LLNL. Most students are unaware of these career-path opportunities and are inadequately trained to pursue them. At present, divisions like DCOM have no choice but to spend an average of two years training new hires to the point that they can contribute on the large ASCI codes. This is a costly and high-risk process because of the time investment needed by current employees to determine if newly hired employees will work out. As a result, student internships are a critical part of LLNL's overall recruiting strategy to help create an external pipeline of college and university students who have had direct contact with NNSA science through their on-site research experiences.

## Partners

Partners within LLNL include management and researchers from the Computing Applications and Research Department, the Center for Applied Scientific Computing (CASC), ITS, and the Institute for Scientific Computing Research (ISCR).

Professional societies, including the Society for Industrial and Applied Mathematics (SIAM), the Institute of Electrical and Electronics Engineers Computer Society, and the American Physical Society, have recently created activity groups in computational science and engineering. CASC and ISCR personnel are directly involved in some of these professional-society efforts targeting students and are naturally shaping these efforts to include NNSA interests. SIAM now regularly schedules an international conference in computational science and engineering. It is noteworthy that the entire leadership team of four coauthors for the February 2003 meeting comes from LLNL (see <http://www.siam.org/meetings/cse03/>). This includes two of the coauthors of the ITST proposal (Ashby and Keyes), a regular ISCR consultant (Petzold), and a recent ISCR sabbatical visitor (Ghattas).

## Objectives

- Recruit 30 participants for FY03, with a mixture of graduate and advanced undergraduate students.
- Recruit qualified ITST students to seek employment at LLNL as computational scientists.
- Reduce the training time of new Ph.D. graduates hired at LLNL as computational scientists.

## FY02 Accomplishments

- Three student interns have been hired as employees—two in FY01 and one in FY02.
- Forty-eight ITST internships have been awarded, and the recipients (including 14 women) were recruited from 15 different schools. There was an almost even distribution of experience levels, ranging from undergraduate seniors to nearly finished Ph.D. students.
- Topics for interns spanned five of the six general research areas listed above: simulation of transport (6), adaptive mesh refinement (6), scalable numerical methods (6), terascale data sets (15), and parallel tools (15).

## FY02 Accomplishments *continued*

- Students are making genuine contributions to ASCI program goals.
- Six students in FY01 continued working on collaborative projects during the school year, and initial planning indicates three more FY02 students may do the same.
- Ten ITST students from FY01 returned for the summer of FY02; initial estimates indicate that as many as nine students are hoping to return next year.
- The ITST Lecture Series for FY02 contained eight wide-ranging talks on active research areas at LLNL and two talks to help students enhance their presentation and interview skills.

## Evaluation/Assessment

Evaluations are ongoing and include a variety of instruments, including reflective feedback, focus meetings with the supervisors and students, personal meetings, questionnaires, and resulting student products and oral presentations. Anecdotal data in FY02 indicate that participants' research assignments were related to their thesis work and—in the case of advanced undergraduates—“opened their eyes towards graduate opportunities.”

Program success is measured in part by the creation of long-term relationships initiated by the program. During the past few summers, nearly every student has wished to return and as a result, has been placed in indeterminate status for future employment possibilities. ITST has become an essential element of CASC's overall training and recruitment strategy, as well as a cost-effective means of accomplishing research.

## Laser Science and Technology Student Program

URL: <http://internships.llnl.gov/lstsp/>

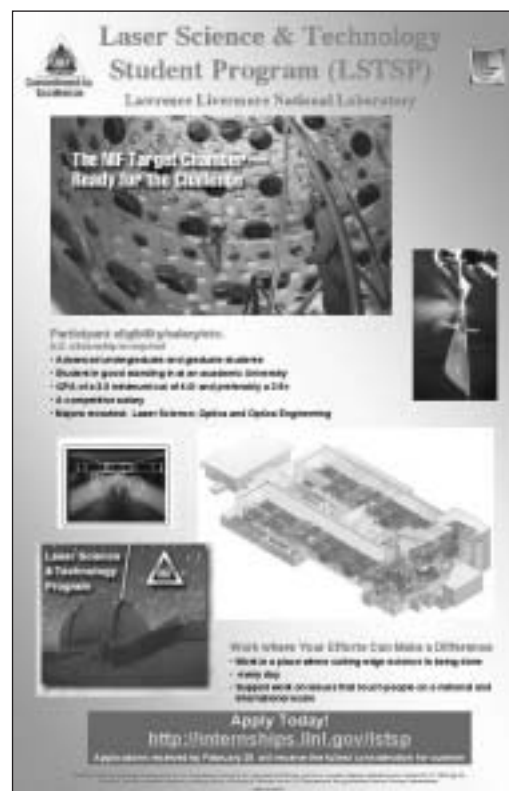
### Purpose

The purpose of the Laser Science and Technology Student Program (LSTSP) is to create a pipeline of trained and motivated potential employees to work at DP laboratories in laser and optics projects. Many of these projects are in NIF and are directly related to SSP. Other projects are associated with laser-materials interactions, such as shock physics and the equations of state of shocked materials, and provide training that is extremely relevant to DP science campaigns and missions. Still others are directly associated with the Yucca Mountain Project (YMP), which is part of a key SSP concern to maintain a safer and cleaner environment.

### Description

The Laser Science & Technology (LS&T) program element within the NIF Directorate has conducted a student research program similar to LSTSP during the past few years. In this program, three graduate students were asked to use the Laboratory's high-power laser facility to study the laser peening of jet engine fan blades and landing gears. These students were given research mentors and developed detailed research plans for their internships. To further enhance the effectiveness of this training program, collaborative research projects with UC Davis and the Metal Improvement Company (MIC) were established to provide exposure for the students to exchange ideas and information with experts from both academia and industry.

The direct intention of LSTSP is to work with the professors and students in universities. For example, the LS&T Program has the capability for laser shock physics, while universities have analytical and mechanical testing capabilities. The combination allows students to perform cutting-edge work on thesis topics that can be openly published yet are directly relevant to high-power laser physics and high-intensity shock physics, two technologies critical to SSP and NIF. This work also has great relevance to important real-world problems as they relate to the performance of military and commercial aircraft and ground vehicles. The result of LLNL laser-peening technology is already impacting over \$3 billion worth of commercial jet planes. The technology also may solve a critical technical problem for the long-term burial of nuclear waste in YMP. A recent unofficial estimate of the potential DOE savings due to laser peening is over \$1 billion.



*Laser Science and Technology Student Program recruitment poster*

After participating in the internship, students will be trained in lasers, laser-generated shock physics, material reactions to shocks, and the prevention of fatigue failure and stress corrosion cracking. These are topics specifically needed by SSP, NIF, and YMP but that are not taught in universities. Students who have completed the internship are precisely the students LLNL will need to carry on our future work. LSTSP will continue to recruit students from universities nationally, with a special initial focus on students from the following universities with whom LS&T has ongoing work or interests: the University of California, Stanford University, UNR, and the University of Texas. Of great significance to DP is that the students engaged in this program will be trained in areas of laser design and development, shock physics, laser-driven shocks, equations of state, and materials response, which are directly applicable to critical missions of the DP laboratories. LSTSP will, therefore, provide students with the exact training and experience desired for future workers in the NNSA/DP complex.

## NNSA/DP and LLNL Mission Benefits

There is a continuing shortage of personnel to activate, operate, and solve problems associated with NIF. To date, there is an opening for a lead scientist to support the commissioning of NIF, as well as numerous positions in support of subsystem activation. However, there are not enough trained people available with the appropriate background in high-power laser and optics technology. At present, the need is being partially filled by borrowing personnel from other DOE programs, but this is clearly not a solution.

A better long-term solution is to train scientists and engineers through a continuation of the CSIP. The goal of this program is to attract new students and meet the workforce needs for future DP missions. Recent recruiting efforts have repeatedly indicated that native-born U.S. citizens applying to LLNL account for only 20% of the qualified applicants. Many of the otherwise qualified applicants are citizens of foreign countries. The U.S. citizenship requirement for work in defense-related projects makes recruiting qualified scientists and engineers a challenge. LSTSP provides a proactive recruiting strategy to help increase the number of applicants who are U.S. citizens. To date, one of the students associated with our student program in laser peening has graduated from UC Davis and has accepted employment at the Laboratory as a mechanical engineer in support of the NIF Directorate.

Since the events of September 11, many new programs in the national-security area have been developed. LSTSP provides LLNL, NIF, and LS&T with an opportunity to attract new graduates and meet the need for future employees in this DP area. Continued support of LSTSP will enable the Laboratory to develop future generations of scientists and engineers and revitalize the nuclear weapons complex for DOE.

## Partners

- MIC, the LS&T's laser-peening Cooperative Research and Development Agreement partner, has established a laboratory at LLNL that would have cost DOE several million dollars to build. MIC staffs the laboratory with two full-time people, covers operating expenses, and continues to provide peening and laser shock services to the students. MIC staff members routinely train our students to peen and shock materials at no cost to them. The in-kind contribution to this student project (including hardware and services) has a value of \$1 million.

- Partners inside LLNL include YMP, the Engineering Directorate, and the NIF Directorate.
- University partners include Prof. Michael Hill of UC Davis.

## Objectives

- Recruit scientists within SSP at the Laboratory, with a special emphasis on NIF.
- Recruit scientists and engineers to support YMP and its objectives.
- Continue to provide internships to advanced undergraduate and graduate students in the areas of laser sciences, optics, and optical engineering; recruit a total of 14 upper-division undergraduate and graduate students to participate in the FY03 internship. The students will be assigned to research projects in LS&T and Engineering.
- Enable LSTSP participants to perform hands-on research projects under the supervision of LS&T or Engineering research scientists. These students will participate in experiments on laser materials processing, such as laser peening and precision drilling, providing them with first-hand knowledge of high-power pulse-laser technology, which is key to the success of NIF, stockpile stewardship, and national defense.
- Make it possible for LSTSP interns to be trained and mentored by prominent LS&T scientists. It is further anticipated that students will have direct interactions with the one or two postdocs associated with LSTSP. Workshops on laser peening and laser drilling will be organized toward the end of the second year of the program to engage interested students and technology users such as DP weapon designers, NIF scientists, and DoD technologists. The workshops will focus on the relevance of the student training to the stockpile stewardship responsibilities jointly shared by DOE and DoD.
- Allot additional travel funds to enable LSTSP students to visit industrial, military, laboratory, or government facilities interested in applying the processing technologies and to present research outcomes at conferences. These activities will provide exposure for the students to pursue scientific careers at DP laboratories.
- Increase the number of qualified undergraduate students who are U.S. citizens; pursuing degrees in laser science, optics, or optical engineering; and interested in working in the NNSA/DP complex.

## FY02 Accomplishments

- In past few years, four of LS&T's top new hires were previous LLNL student interns.
- Five students (one undergraduate and four graduate students) were selected to participate in LSTSP. Three of the students are now continuing their graduate research work at UC Davis, and one student is now performing her advanced study at the University of Notre Dame. The students were assigned research mentors and are completing research projects.

## FY02 Accomplishments *continued*

- Significant progress has been made in the laser-peening area. As a result, two scientific papers were published in reputable engineering journals, and five technical presentations were made at American Society for Testing and Materials (ASTM) and international conferences in 2002.
- The results from one student project will be directly applied to improve the fatigue lifetime of the 7049 aluminum trunnion in landing-gear peening of U.S. Air Force T-38 jets, saving the government millions of dollars. An extension of this same research may lead to solving a very critical and expensive problem regarding the cracking of F-16 fighter-jet tail sections, saving the government many additional millions of dollars.
- A summary of LSTSP-related publications and presentations are listed below.

### **Journal papers published by LSTSP students in 2002:**

- J. E. Rankin and M. R. Hill, "Measurement of thickness-average residual stress near the edge of a thin laser-peened strip," *Journal of Engineering Materials and Technology*, April 2002.
- J. E. Rankin, M. R. Hill, and L. A. Hackel, "The effects of process variations on residual stress in laser-peened 7049 T73 aluminum alloy," *Material Science and Engineering A*, March 2002.

### **Conference papers and presentations given by LSTSP students and their research teams in 2002:**

- M. R. Hill, *Adventures in measuring residual stress by slitting*, Workshop on Residual Stress Effects on Fatigue and Fracture Testing and Incorporating Results into Design, ASTM Committee E08 on Fatigue and Fracture, Pittsburgh, Pennsylvania, 2002.
- M. R. Hill, L. A. Hackel, and F. Harris, *Laser peening for aircraft maintenance and manufacture*, NCMS/CTMA Working Symposium on Sustainment: Strengthening America's Military Readiness, Jacksonville, Florida, April 2002.
- J. E. Rankin, M. R. Hill, et al., *The effects of process variations on residual stress induced by laser peening*, Sixth European Conference on Residual Stresses, Coimbra, Portugal, July 2002.
- J. E. Rankin, M. R. Hill, et al., *Engineering and economic considerations for life-extension by laser peening*, Sixth Joint FAA/DoD/NASA Conference on Aging Aircraft, San Francisco, California, September 2002.
- R. Specht, D. Jones, et al., *Process control techniques for laser peening of metals*, Eighth International Conference on Shot Peening, Garmisch-Partenkirchen, Germany, September 2002.
- The students developed a technique to measure the residual stress in laser crystals to prevent their cracking when cutting into slabs. These crystals are key components in developing a future fusion-energy laser driver funded by the DOE Fusion Energy Program.
- As the students work toward their advanced degrees, they are now trained in both lasers and laser-generated shock physics. These are topics needed by SSP and NIF but that are not taught in universities. One of the students associated with the laser-peening

## FY02 Accomplishments *continued*

collaboration with UC Davis has accepted an engineering position within the NIF Directorate and began employment in September 2002. LS&T plans to recruit more qualified students from universities to provide the training and experience desired for future workers in the NNSA/DP complex.

## Evaluation/Assessment

The work of LSTSP students will be evaluated to determine their understanding and ability to apply experimental and modeling concepts to solve real stockpile problems. LLNL research mentors will work with teaching faculty to identify the best potential LSTSP participants for recruitment. The success of LSTSP will be determined by a survey of student awareness and interest in employment at LLNL and the quality of the research conducted under the program.

## National Ignition Facility Laser Internships

URL: <http://internships.llnl.gov/NIFLI/>

### Purpose

NIF staff members are now activating the first bundle of laser beams on the system. Activation will continue until all 192 beams are completed. NIF will operate for decades afterwards, producing thermonuclear burn in the laboratory. The purpose of the NIF Laser Internships (NIFLI) program is to help prepare for NIF workforce needs by training young scientists on a moderately sized fusion laser known as the Mercury laser. The Mercury laser is currently DP-funded and is part of a comprehensive \$25 million-per-year national campaign focused on developing the future laser drivers needed for fusion energy. Mercury will generate the highest energy per pulse (100 joules) of any repetitively pulsed laser and will operate at 10 shots per second (NIF fires at 0.2 shot per hour), thereby allowing students to acquire data at a rapid rate with advanced diagnostics. In addition to becoming intimately familiar with critical laser technologies, the selected graduate students will learn about the broader fusion community as it pertains to HEDP, ICF, radiation physics, and materials science. At present, Mercury operates at 12 joules per pulse and up to 3.3 shots per second. It is currently being used to perform laser-science experiments. The next phase of development will increase the energy to the 100 joules level at 10 hertz.

As LLNL moves toward NIF operation, the Mercury laser offers a unique opportunity to recruit and mentor outstanding young laser physicists to work at Livermore. The Mercury laser is exciting to young laser physicists because it will be a state-of-the-art tabletop laser useful for high-energy laser experiments. Students will be able to perform Ph.D.-level research by helping to develop and activate Mercury components, including the high-average-power frequency conversion module; short-pulse, spectrally sculpted front-end; and wave front-correction optics. Thesis work may also include the study of materials, electronics, and laser engineering—giving students the educational and experimental breadth to become first-rate laser scientists.

### Description

Thesis topics are matched with the participants' scientific interests and background. Laboratory researchers will devote the necessary time to guide participants on their research topics. Thesis topics are also formally reviewed by thesis advisors for academic appropriateness. For example, the three component areas included in one LSTSP student's work were

- high-average-power frequency conversion,
- short-pulse lasers, and
- wave front correction.

These research topics are timely and exemplify how student research experience can dramatically impact the future of fusion lasers. In this case, the student's setup will be integrated into the Mercury facility, giving him both small- and large-scale experimental experience.

Weekly meetings are held for the students with their UC Davis thesis advisors to provide a forum for students to interact, receive coaching, stay abreast of current topics, and practice oral presentations. Students are required to publish their work in refereed journals and to give presentations at conferences. The students will interact closely with Mercury laser staff,

professionals within NIF, and other divisions within the LLNL complex. End-of-the-year gatherings recognizing technical and academic accomplishments will be hosted, and Laboratory-wide seminars will be conducted to help increase the visibility of student work.

## NNSA/DP and LLNL Mission Benefits

As NIF's activation accelerates, young, enthusiastic scientists will be sought. However, the enormity and complexity of the NIF demand that personnel with responsibility be pretrained on another fusion laser. Mercury is an ideal laser for this role because it shares many optical and technological features with NIF. Furthermore, Mercury is large enough to have the feel of a facility, yet small enough to permit individual initiative. NIFLI will focus on several critical-skills categories; the primary category is laser physics, including optical engineering, fundamental laser-plasma interactions, nonlinear mathematical analysis, and beam diagnostics. The students will also broadly encounter issues relating to inertial fusion energy and power plants.



*National Ignition Facility Laser Internships recruitment poster*

One of the critical needs for DP in the foreseeable future is a workforce knowledgeable in the design and operation of large laser systems. Unfortunately, in the last six years, the number of Ph.D.s awarded in the United States has declined by 22%. This decline, coupled with serious competition from industry for scientists and engineers, has led to a predicted 40% shortage in the DOE technical workforce over the next five years. Our proposal aims to motivate undergraduate and graduate students to pursue and complete their doctoral degrees by providing an invigorating educational experience. In addition, students trained on the Mercury laser system, the first high-energy solid-state laser system based on diode-pumping (instead of flash lamps), will be well-prepared to transition to NIF and other major fusion laser facilities after receiving their degrees since the Mercury laser is designed with many of the same optical principles as NIF.

## Partners

- Partners include Prof. Denise Krol of UC Davis DAS and scientists within the NIF and PAT directorates.
- Funding for experimental equipment will be provided through the DP High-Average-Power Laser program, involving DOE laboratories (LLNL, Sandia, Los Alamos, Oak Ridge National Laboratory), a DoD laboratory (Naval Research Laboratory), universities (University of Wisconsin, UC San Diego), and defense contractors (General Atomics, Schafer). Funding is currently at \$25 million per year for the national program.

- NIFLI will partner with the Laboratory's summer intern program, DNT summer students, and CSIP's internship opportunities and will link students to other NNSA/DP interns to foster a broader understanding of SSP activities.
- This project is a collaboration between LLNL staff and local universities and colleges. One of the principal investigators on this project has been an adjunct college professor at UC Davis, while the other is an adjunct faculty member at Las Positas College. NIF scientists are excited about the prospect of working with NIFLI graduate students and will offer comprehensive thesis projects within the fusion laser sciences. The scientists deeply value the influx of young minds eager to solve complex problems with fresh, new perspectives and enjoy the contributions that they make to the atmosphere within the Laboratory.

## Objectives

The primary objective of NIFLI is to train and expose students to laser physics on a moderately sized state-of-the-art laser system. Students will participate in experiments, assist with data analyses, and be asked to conduct individual experiments in an offline laboratory. NIFLI focuses on mentoring two outstanding graduate students, one who is successfully underway and another who promises potential as a member of the NIF team. The NIF Directorate has identified and committed to the training of Jason Schmidt, a full-time experimental graduate-level student, who arrived at the Laboratory on July 15, 2002. Jason's experimental thesis topic requires a significant investment of time and funds from his advisors in the Mercury laser project. The NIF Directorate has ordered all of the components that Jason requires to build, activate, and test a new concept for the front-end laser. Meanwhile, Jason has already become a productive team member with the Mercury staff. He would like to stay for at least 12 months, in light of the difficulty of dividing his academic commitments between LLNL and the University of Colorado at Boulder.

In addition to continuing the support of the existing student, NIFLI also hopes to add a summer student who will focus on the optical modeling of the laser system. Laser modeling, while requiring less hands-on activity than an experimental topic, is a crucial skill for NIF.

## FY02 Accomplishment

- The present NIFLI student arrived on July 15, 2002, and has begun work on the front-end development and diagnostics of the Mercury laser. He is developing optical parametric chirped-pulse amplification (OPCPA), an important technology for Mercury and extremely high-intensity petawatt lasers. Specifically, he is developing the OPCPA component, as well as the diagnostics for broadband amplification. The student has also been meeting regularly with nine other graduate students associated with a professor from UC Davis. This venue allows the students to broaden their networks and examine issues important to other student projects.

## Evaluation/Assessment

Our metric for success will be based on the quality of the Ph.D. work and the student's potential for employment within LLNL and the NIF Directorate.

## Nuclear Science Internship Program

URL: <http://internships.llnl.gov/nsip/>

### Purpose

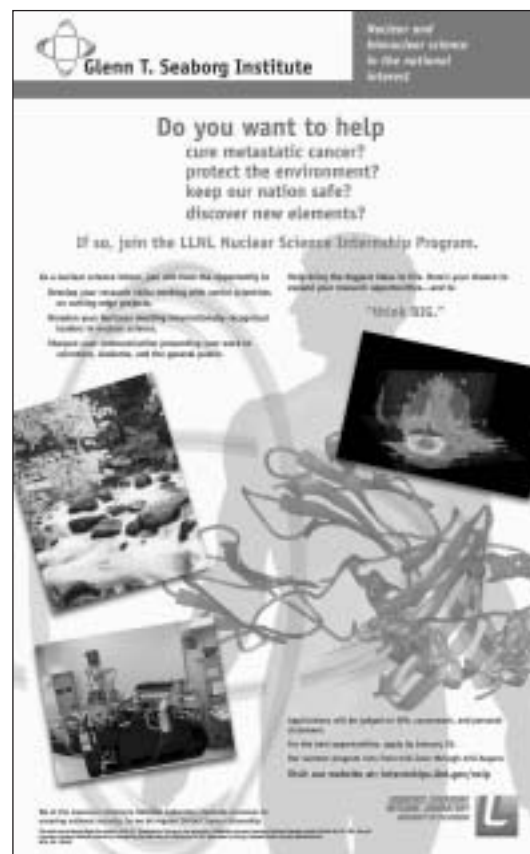
The purpose of the Nuclear Science Internship Program (NSIP) is to develop a robust pipeline of nuclear scientists to meet national-security needs. Our program consists of graduate and undergraduate student internships at LLNL, scientific collaborations with academic institutions, and educational-outreach activities (e.g., workshops and lectures) by LLNL staff and academic collaborators. Our goal is to ensure a nuclear-science workforce that is technically competent, diverse, and relevant in the nuclear-science critical skills required by NNSA national-security missions.

During the era of weapons testing, diagnostic characterization of post-shot weapon products was performed using radiochemistry and mass spectrometry. Prompt radiation-detection techniques—applied in real time to device explosions—provided further data for weapon performance assessment. The nuclear-science critical skills required for these activities—radiochemistry, mass spectrometry, and radiation detection—are decisive tools for realizing the SSP aim of reconciling 3-D computer simulations with archived diagnostic data from previous weapons tests. These critical skills also continue to be essential for enhanced test readiness and are central to nuclear-science applications in energy, environment, and health.

Ironically, the intense NNSA needs for these skills occur at a time when radiochemistry programs are rapidly being downsized in U.S. universities. There is only one U.S. university that produces a viable stream of mass spectrometrists who are capable of initiating new instrument and procedure design, and radiation-science groups are increasingly focusing their attention exclusively in medicine. Thus, graduates in these specialties are becoming progressively harder to direct toward national-security applications. Moreover, national-security laboratories face stiff competition from the health-care industry, state governments, agencies, and non-NNSA federal organizations for the services of such graduates.

NSIP is designed to encourage the growth of academic programs in critical-skills areas by increasing student and faculty access to nuclear research staff and facilities. Specifically, NSIP seeks to attract and train the following:

- **Nuclear and radiochemists** to safely handle, manipulate, and separate radioactive



*Nuclear Science Internship Program recruitment poster*

materials; measure isotopic composition and decay properties; and understand the fundamental chemical and materials properties of radioactive elements, particularly plutonium and uranium.

- **Mass spectrometrists** to measure isotopic compositions, make accurate trace-element determinations, and design new instruments and procedures for greater sensitivity and efficiency.
- **Radiation scientists** to measure complex radiation signatures and decay properties and to simulate radiation transport in 1-, 2- and 3-D objects.

## Description

The multipronged NSIP recruiting strategy at LLNL is aimed at locating potential applicants from a diverse set of institutional resources. LLNL Seaborg Institute personnel will

- contact participants in the FY02 American Chemical Society (ACS) Nuclear Summer School, the California Institute of Technology (Caltech) Summer Undergraduate Research Fellowships, and the LLNL Undergraduate Summer Institute.
- visit at least five college or university campuses in order to initiate research relationships, strengthen existing collaborations, and recruit students with direct personal contact.
- review applicant pools from targeted programs, the CSIP program, and individual referrals.
- share Livermore's NSIP applicant pool with the Los Alamos Seaborg Institute, enabling both programs to match students with the education opportunities at the UC/DP laboratories that are best suited to each student's strengths and interest.

Successful applicants to the summer internship program are assigned LLNL staff mentors. These mentors are drawn from research teams in the critical-skills specialties emphasized in our program: mass spectrometry, radiochemistry, radiation simulations, and radiation detection. Each intern project is coordinated by his or her mentor using research facilities and resources unique to LLNL. Project topics focus on nuclear-science applications in basic research (physics and chemistry), stockpile stewardship, biomedicine, the environment, and nonproliferation. A summer-program lecture series featuring prominent nuclear-science experts is organized to reinforce NSIP research specialties and stimulate intern interest by exposing them to the best minds in nuclear science. At the end of the summer program, each intern is required to summarize his or her research in a poster, give an oral presentation in a formal poster session, and prepare a Web page on the research project for posting on the LLNL Seaborg Institute Web site.

## NNSA/DP and LLNL Mission Benefits

The objectives of the NSIP effort are directly aligned with the NNSA/DP campaigns in support of SSP. Specifically, by attracting and training junior scientists in the areas of nuclear science, radiochemistry, mass spectrometry, and general radiation science, NSIP contributes to the following NNSA/DP campaigns:

### ***Primary and Secondary Certification Campaigns***

Nuclear science and radiochemistry are key critical skills in support of the Primary and Secondary Certification Campaigns. In particular, radiochemistry is at the heart of weapons-performance evaluations. A comprehensive understanding of the relationship between the production of radioisotopes and stockpile performance, as archived from nuclear test data, can only be achieved by trained specialists who have a broad-based knowledge of nuclear science as well as nuclear weapons design. Moreover, the *Nuclear Posture Review* recommends that the NNSA/DP laboratory complex retain a workforce skilled in those specific science and technology areas needed in the advent of a resumption of nuclear testing. Radiation simulations and detection, radiochemistry, and mass spectrometry are clearly such critical-skills areas.

### ***Dynamic Materials Properties Campaign***

The objective of the Dynamic Materials Properties Campaign is to provide science-based and experimentally validated models of the dynamic response of materials under conditions of pressure, temperature, strain and strain rates of relevance to nuclear explosions. Besides the confines of dynamic materials properties, this campaign also supports efforts in physical-data research, including fundamental materials properties (equations of state, constitutive properties, etc.), radiative properties (opacity etc.), and nuclear properties (nuclear cross sections etc.) The NSIP education program directly supports the Dynamic Materials Properties Campaign through training in the field of fundamental physical-data and actinide-chemistry research.

### ***Advanced Radiography Campaign***

A key objective of the Advanced Radiography Campaign is to develop next-generation radiographic tools and diagnostics based on proton radiography. This effort critically depends on a workforce skilled in the area of nuclear physics and radiation science to predict radiation transport through 3-D objects that are dynamically imploded. The NSIP objectives are aligned with the goals of this campaign by training personnel in the fields of nuclear physics, radiation detection, and radiation simulations.

### ***Advanced Simulation and Computing Campaign***

A key objective of the Advanced Simulation and Computing Campaign is to develop 3-D high-fidelity, end-to-end full system simulations. Archival test data serve as the basis for validating these simulations against measured yield inferred from the production of special radioisotopes. By training personnel in the area of radiochemistry, the NSIP effort supports the acquisition of key data and expertise to validate these codes through direct comparisons between calculated and measured yield.

In addition, NSIP student interns at LLNL will be part of the overall recruiting strategy to help create an additional external pipeline of college and university students who have had direct contact with NNSA science through their on-site research experiences.

## **Partners**

In previous years, the Seaborg Institute's summer program drew its projects and mentors exclusively from the Analytical and Nuclear Chemistry Division of the CMS Directorate. By

contrast, the FY02 program drew on all divisions in the CMS Directorate; the PAT and Nonproliferation, Arms Control, and International Security (NAI) directorates; and faculty collaborators and co-mentors at UC Berkeley and UC Davis. This extended collaboration expanded NSIP project research facilities to include access to time-of-flight secondary ion mass spectrometry, electron microscopy, cryo-microcalorimeter detectors, networked radiation detectors, linear accelerators, film and thermoluminescent dosimeters, and intelligence experts, in addition to the existing radiochemistry, synchrotron, secondary ion mass spectrometry, and high-end computer environments from past summers that continue to be used. The payoff for our summer interns was the fruitful intensity of their interactions with one another and the energy they invested in their projects.

Our partners outside LLNL continue to be university programs and national laboratories. NSIP intends to strengthen linkages with the Los Alamos Seaborg Institute and the Seaborg Center at the Lawrence Berkeley National Laboratory (LBNL), particularly to coordinate internships and nuclear-science education resources. NSIP is also initiating short courses in glove-box safety and radiation transport, which are targeted primarily to Laboratory employees and other midcareer scientists. While these courses are not immediately relevant for all NSIP students, the materials and teaching staff for these programs will be made available to students and will no doubt be of significant value to students specializing in radiochemistry and radiation science.

Robust partnerships for collaborative research and student internships were established in FY02 with MIT, UC Berkeley, and UC Davis. Negotiations continue with Caltech, the University of Michigan, the University of Wisconsin-Madison, and Washington State University for similar partnerships.

## Objectives

- Establish collaborations with key academic institutions, and use these collaborations to identify and recruit potential nuclear-science students.
- Recruit 20 undergraduate (juniors and seniors) and first-year graduate student participants per year for summer research experiences.
- Initiate contractual research relationships with two to four university faculty members, as evidenced by joint publications and presentations.
- Work with university faculty collaborators to attract and support on average three graduate students each year; require graduate students to spend at least two months at LLNL per year, working with DP scientists.
- Work closely with graduate programs to ensure that students receive appropriate coursework in nuclear physics, nuclear chemistry, and radiation detection.
- Coordinate with Los Alamos scientists through the Los Alamos Seaborg Institute to ensure maximum NNSA efficiency in student recruitment, retention, and hiring.
- Provide undergraduate students with information about graduate studies in nuclear science, leveraging the resources already provided by the ACS Nuclear Science Summer School's list of graduate-school programs.

- Provide postdoctoral and career job opportunities to successful nuclear-science Ph.D. graduates.

## FY02 Accomplishments

- The resources provided by NSIP in FY02 led to substantial growth in the scope and diversity of the Seaborg Institute Education Program.
- Our 2002 summer intern program consisted of 15 students (9 undergraduate and 6 graduate students), compared with 6 students last summer. In addition, NSIP hosted an additional five program-sponsored students who were working on radiation detection for national-security applications. This increase in the number of interns was amplified by participation (and monetary support) from a number of LLNL organizations (e.g., the PAT and NAI directorates and the Materials Science and Technology Division and the Chemistry and Chemical Engineering Division of the CMS Directorate).
- Four undergraduate interns and five graduate interns were invited to continue their affiliation with their respective research groups after the end of the NSIP summer program.
- The summer program included 11 lecturers from LLNL, Los Alamos, LBNL, Brookhaven National Laboratory, UC Berkeley, Caltech, the University of Michigan, Virginia Commonwealth University, and the Flerov Lab of Nuclear Reactions in Dubna, Russia.
- One of the graduate interns was awarded the inaugural Darleane Hoffman Fellowship, which encourages and rewards graduate-student excellence in radiochemistry and actinide science.

## Evaluation/Assessment

Feedback from NSIP summer participants continues to be supportive of the unique research experience and opportunity to use equipment not typically available at universities. Additionally, students are very pleased to have the opportunity to network among renowned researchers, a broad-and-diverse R&D population of researchers, and summer students. Informal polls of the students showed that the summer lecture series was a good match with their school courses. In addition, a great deal of camaraderie was established among the students. They worked on their projects together and took weekend trips together. Evaluation of the students' research was determined in part by their participation in the LLNL Student Research Symposium. The symposium required that the students prepare poster presentations based on their summer projects. The NSIP students prepared very high-quality posters.

The remainder of the NSIP evaluation process includes individual mentor–intern reflective feedback, focus meetings (with Seaborg Institute staff, mentors, and interns), questionnaires, and discussion groups on research topics (from the summer lecture series and intern projects).

## Systems Administration Computer Support

URL: <http://step.llnl.gov/sacs/>

### Purpose

The goal of this project is to develop and implement a comprehensive program that integrates classroom learning with workforce preparation and training in support of computer science systems administration (for national security) at the DOE laboratories. Through collaborations with two- and four-year academic institutions, LLNL technical staff will establish Systems Administration Computer Support (SACS) internships that provide students with on-the-job training so that they are qualified for entry-level, skilled technical positions.

### Description

LLNL technical staff will start expanding the program by engaging additional local two- and four-year academic institutions to collaborate in establishing SACS internships. A collaboration with Las Positas College has already been initiated, and the technical staff will attempt to expand the program to include Ohlone College and DeVry Institute. As in the previous year, as part of the recruiting strategy, Computer Systems Support (CSS) staff will again attend job fairs, serve as guest speakers at classes to attract students, and tap into faculty and students for recommendations. Recruitment is year-round, as participants can arrange flexible work schedules (co-op, part-time,

etc.) while attending community college. LLNL courses and classes are also made available to the students to further their educational hands-on experience.



*Systems Administration Computer Support recruitment poster*

### NNSA/DP and LLNL Mission Benefits

Over the past year, the Computation Directorate has reorganized to better align itself in meeting the LLNL mission and, specifically, in support of those organizations directly related with DP funding. The CSS Division is now part of the Integrated Computing and Communications Department within the Computation Directorate. This places desktop support and high-performance computing in a single organization in order to provide DP customers with desktop-to-teraflop operational support in a more cohesive manner. The reorganization recognized the importance of desktop computing in building and retaining critical skills in the systems-administration and high-performance computing arena.

In FY02, CSS had 15–25 positions open at any given time for technical support personnel. This is beyond the 20+ employees hired by CSS. More than 85% of

these positions have been in organizations directly related to DP funding. The others are in organizations that support programs that interact with DP. The technical staff members who are hired need to have specific skills and experience that are not readily obtained in outside industry (e.g., support for the Macintosh platform). To meet the growing computing needs of LLNL, the CSS Division must try to grow its own experts, especially since the computing expertise that is available is difficult to recruit because of the proximity of Silicon Valley and high-tech industries.

## Partners

- Partners within LLNL include the Computation Directorate in support of ASCI; NIF; CMS; the Safety, Security, and Environmental Protection Directorate; the Energy and Environment Directorate; the Biology and Biotechnology Research Program; and CSS.
- Externally, academic institutions include Las Positas College, with potential expansion to Chabot College, Ohlone College, DeVry Institute, and Modesto College.



*One of the FY02 Systems Administration Computer Support interns*

## Objectives

- Expand to other local community colleges in keeping with the growing demand for SACS participants, and increase placements to eight or more participants.
- Provide co-op work experience programs for students to develop skills using school course materials and job duties.
- Provide faculty training and internships to encourage the transfer of technology skills into the classroom and to increase the understanding of workforce needs and concerns.

## FY02 Accomplishments

- Since the beginning of SACS, 100% of the participants have been retained as FTE or flex-term employees, or are still in a SACS student status.
- Many students entering internship projects find that the projects help to focus and/or change their educational interests. One such example is an African-American SACS participant who has decided to pursue a computer science degree. She has received a scholarship from LLNL and is now a participant in the ASCI Pipeline program.

## FY02 Accomplishments *continued*

- One FY01 student was hired as an FTE into an entry-level (593.1) classification.
- One FY00/01 student was hired as an FTE into an intermediate-level (593.2) classification. (The SACS goal had been to hire entry-level employees. This was the second student hired at the intermediate level.)
- The remaining FY00/01/02 students were hired directly into their programs (continuing as students) with 100% funding by the program.
- As of August 2002, two FY02 students are currently under consideration for FTE positions.
- A contact for DeVry Institute has been identified, and resumes from the DeVry Institute career fair were reviewed.

## Evaluation/Assessment

Evaluations are ongoing, but the final success of the program is measured by program growth through the increased placement of students. Two FY01 participants were hired as FTE employees in FY02. Of the five FY02 interns, three are under consideration for flex-term or FTE hires in late FY02 or early FY03, and two will continue as summer students or in indeterminate status while continuing their studies.

## Section 2: Military Academic Research Associates/Reserve Officer Training Corps

*STEP Contact: Barry Goldman, (925) 422-5177, [goldman1@llnl.gov](mailto:goldman1@llnl.gov)*

### Introduction

To ensure our nation's security, the United States requires a scientifically and technically literate workforce for both civilian and military personnel. In the case of the military, it is important that officers are knowledgeable about the science and technology capabilities of the major Department of Defense (DoD) and Department of Energy (DOE) laboratories so that these capabilities can be used to improve military services.

Working with the LLNL National Security Office, STEP manages a program called Military Academic Research Associates (MARA). MARA is also a partnership with the DOE National Nuclear Security Administration (NNSA) national laboratories, thereby enabling MARA to leverage the rich scientific and technical base of all three laboratories—Lawrence Livermore, Los Alamos National Laboratory (Los Alamos), and Sandia National Laboratories (Sandia).

In an effort to expand the DOE/DoD connection, the Critical Skills Internship Program (CSIP) Manager continues to identify ways to strengthen this collaboration. The Reserve Officer Training Corps (ROTC) internship program, a spinoff of the MARA program, offers opportunities to ROTC cadets and midshipmen from within the state of California and throughout the entire nation. Similar to the MARA program, the ROTC internships help to ensure that the U.S. workforce for both civilian and military personnel is scientifically and technically literate.



*Senator John Glenn with MARA and ROTC participants during an FY02 visit to LLNL*

## Military Academic Research Associates

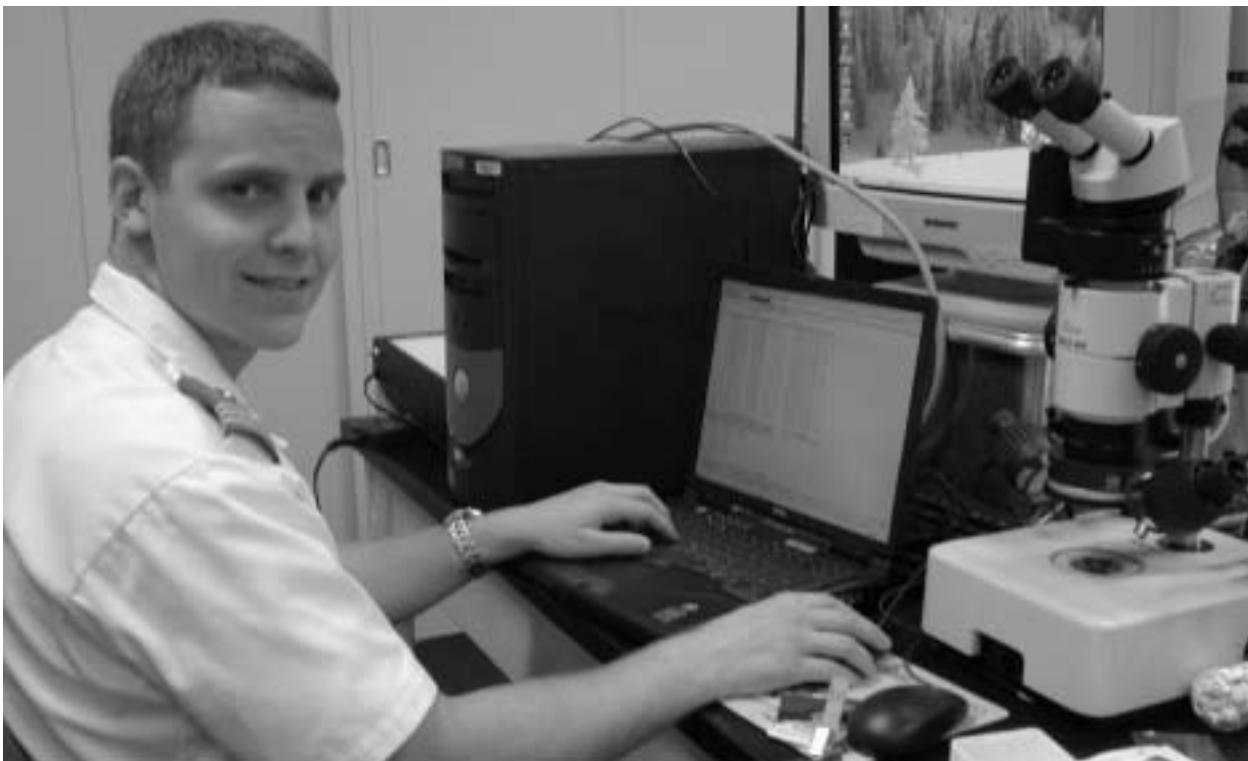
URL: <http://step.llnl.gov/mara>

LLNL has been working with the undergraduate military academies, as well as several of the graduate institutions, to provide internship opportunities for military cadets and midshipmen. The military cadets and midshipmen are given opportunities to participate in ongoing, collaborative, multidisciplinary teams that are pursuing scientific and technical solutions to some of our nation's most challenging problems—many of which are critical to national defense.

MARA appointments typically last for four to six weeks during the summer. Cadets and midshipmen work in areas such as the National Ignition Facility (NIF), stockpile stewardship, advanced manufacturing, high-performance computing in the Advanced Simulation and Computing (ASCI) Program, nonproliferation and arms control, intelligence assessment, and other projects that represent programs focusing on national-security issues.

MARA interns become aware of and participate in the LLNL national-security mission by

- immersing themselves in their research projects,
- participating in seminars and tours,
- completing electronic portfolios with project briefs, and
- delivering technical presentations to their peers.



*A MARA FY02 intern from the U.S. Military Academy*

While at LLNL, MARA interns

- continue to receive military pay;
- are provided with accommodations and local transportation; and
- receive reimbursement for their transportation to LLNL, as well as a per diem.

MARA cadets and midshipmen are required to summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the intern's major, military institution, LLNL research project, perceived benefits by the participant, and any additional Web resources for more information. Portfolios can be viewed online at <http://internships.llnl.gov/portfolio/> by clicking on the "Military Academic Research Associates (MARA)" link. In FY02, there were 24 MARA interns at LLNL, as well as two faculty members from the U.S. Military Academy.

MARA applications may be completed and submitted through a single Web site for all participating laboratories by visiting <http://internships.llnl.gov/mara> and clicking on the "Application" link. Applicants must be U.S. citizens with a grade point average of 3.0 or higher. Applicants must apply by January 31 to receive full consideration for a summer internship since the majority of hiring departments make their selections from March to May. The final deadline for submitting an interest form for summer employment is March 31.



*A MARA FY02 intern from The Citadel*

## Purpose

The MARA project has the following goals:

- To foster a stronger relationship with the military, enhance the tie between DoD, LLNL, DOE, and the Office of Defense Programs (DP), and address the recommendations of the Chiles Commission.
- To satisfy future workforce needs, following military commitment or retirement.

## Description

Cadets and midshipmen are recruited through partnerships with the U.S. Air Force Academy, the U.S. Naval Academy, the U.S. Military Academy, and others. Thus far, STEP has successfully partnered with all of the aforementioned academies to provide summer experience tours. STEP aggressively recruits projects for cadets and midshipmen in the winter and communicates these



*MARA FY02 interns from the U.S. Naval Academy*

projects to students from January to March. Cadets and midshipmen bid on assignments in February, and the final decisions on their summer tours are resolved in March and April. In addition, ongoing discussions encourage military academy faculty to experience research at LLNL.

A Web site (<http://internships.llnl.gov/mara>) provides links to the interest form; examples of past military assignments in the form of electronic portfolios; and MARA briefings, program requirements, and qualification criteria. Each summer LLNL hosts 20 to 25 cadets and midshipmen, as well as a few faculty members. Each participant spends four to six weeks working on a dedicated project. In addition to completing their research assignments and attending all military briefings in uniform, participants are required to give their technical peers closeout briefings at the conclusion of the tour and complete electronic portfolios. (See Appendix 3: Student Presentations and visit <http://internships.llnl.gov/portfolio/> for examples of past research assignments and portfolios.)

The respective military academies continue to pay the cadets' or midshipmen's salary, and LLNL funds the interns' travel, lodging, shared rental car, and per diem.

## Partners

### *Laboratory*

- Defense and National Security Office within LLNL
- Los Alamos National Laboratory

- Sandia National Laboratories, New Mexico
- Oak Ridge National Laboratory
- Idaho National Environmental and Engineering Laboratory

### **Non-Laboratory**

- Air Force Institute of Technology
- California Maritime Academy
- The Citadel
- Naval Postgraduate School
- U.S. Air Force Academy
- U.S. Coast Guard Academy
- U.S. Merchant Marine Academy
- U.S. Military Academy
- U.S. Naval Academy
- Virginia Military Academy

## **Objectives**

- As stated by the Deputy Associate Director, Military Affairs, National Security Office, “Today’s cadets and midshipmen are the next generation of leaders for their respective services. What they learn at a DP lab will help shape their future ability to understand the broader defense capabilities of the country—including those that reside at Lawrence Livermore National Laboratory.”
- Establish a pipeline for recruitment, following MARA military commitment or retirement.
- Expose cadets, midshipmen, and graduates to military research at LLNL.
- Facilitate civilian and military faculty research collaborations.
- Ensure that cadets and midshipmen benefit from the technology experience, learned techniques, networking, publications, and exposure to issues of national defense.

## **FY02 Accomplishments**

- FY02 was the largest summer program, with 24 cadets and midshipmen.
- Expanded the briefings to twice weekly to capture more DoD/military projects, including overviews of the Defense Threat Reduction Agency (DTRA), NNSA, and Strategic Command (STRATCOM).
- Offered a weekend (one-day) calm-water rafting trip, which became a highlight of the civilian experience.
- Provided NIF and plutonium facility tours during the MARA briefings to allow all participants to experience the facilities and briefings by representatives of the National Security Office.



*MARA internships recruitment poster*

## Evaluation/Assessment

The majority of participants continue to learn of the MARA program from their academy point of contact, an academy flyer, peers, or an LLNL representative briefing at their respective academies. While 42% of MARA participants chose a national laboratory because of its reputation, 19% chose LLNL because of the match to their interests, and 19% chose LLNL because of the diversity of the offered projects. All participants agreed that their interests matched their research projects and that their projects were related to their academic backgrounds and education. When asked about their work experiences, one respondent said, “It was challenging enough to intrigue me into wanting to learn more so I could understand it better, but not so hard that I was lost.” When asked what one gains from such an experience, the following responses were given:

- “I was able to learn quite a bit about several different career paths.”
- “The Academy does not have a research program that can afford to be as extensive or in-depth.”
- “Opportunity to do research that actually affects national security.”
- “Real-life application of academic knowledge.”

Cadets and midshipmen typically responded that the people and resources available at LLNL were responsible for the uniqueness of their tour at a national security laboratory. A number of participants commented on the differences when working at a civilian facility and the dedication and professionalism of the employees. After spending the internship in a specific research area, some participants felt that there were no opportunities at their academy within their field of study, or at least not in a multidisciplinary manner, to perform similar research.

When asked how the experience has influenced their career interests, the following responses were given:

- “Gives me a greater interest to pursue specific fields.”
- “My experience has opened my eyes to research opportunities in the government sector.”
- “I am eager to return to the Academy and (hopefully) change my schedule next semester so it includes organic chemistry.”
- “Probably away from actual research to more of a policy aspect of science.”
- “It only made me want to follow my planned military career path more.”

## Reserve Officer Training Corps Interns

URL: <http://step.llnl.gov/rotc>

The ROTC internship program is a spinoff of the MARA program. This program offers opportunities to ROTC cadets and midshipmen from within the state of California and throughout the entire nation. ROTC internships are provided throughout the year, with a focus on the summer, for undergraduate and graduate cadets and midshipmen. ROTC cadets and midshipmen work in areas such as NIF, stockpile stewardship, advanced manufacturing, high-performance computing (ASCI), nonproliferation and arms control, intelligence assessment, and other projects that represent programs focusing on national-security issues.

ROTC interns become aware of and participate in the LLNL national-security mission by

- immersing themselves in their research projects (12 weeks for ROTC interns),
- participating in seminars and tours,
- completing electronic portfolios with project briefs, and
- delivering technical presentations to their peers.

While at LLNL, ROTC interns

- are paid salaries at competitive market rates,
- are reimbursed for transportation to and from their schools or homes, and
- are responsible for their own living arrangements.

ROTC cadets and midshipmen are required to summarize their experiences in the form of electronic portfolios. Each portfolio briefly describes the intern's major, military institution, LLNL research project, perceived benefits by the participant, and any additional Web resources for more information. Portfolios can be viewed online at <http://internships.llnl.gov/portfolio/> by clicking on the "Military Academic Research Associates (MARA)" link. In FY02, there were 11 ROTC interns at LLNL, including one intern who started his Laboratory research experience in the summer of FY01 while waiting to enter medical school in the summer of 2002.

Applications may be completed and submitted through a single Web site for all participating laboratories by visiting <http://internships.llnl.gov/rotc> and clicking on the "Application" link. Applicants must be U.S. citizens with a grade point average of 3.0 or higher. Applicants must apply by January 31 to receive full consideration for a summer internship since the majority of hiring departments make their selections from March to May. The final deadline for submitting an interest form for summer employment is March 31.



*A Navy ROTC intern*

## Purpose

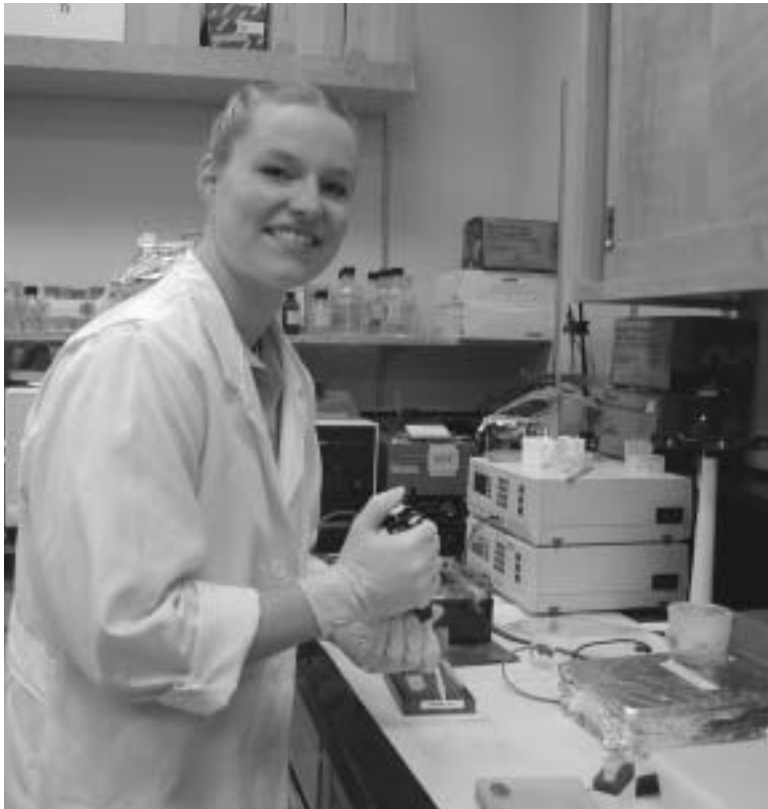
ROTC interns help to foster a stronger relationship with the military and enhance ties among the DoD, Livermore, and the NNSA. LLNL has been working with the military academies and has expanded its program in past years to provide internship opportunities for ROTC cadets and midshipmen. Cadets and midshipmen are given opportunities to participate in ongoing research on multidisciplinary teams that are pursuing scientific and technical solutions to some of our nation's most challenging problems—many of which are critical to national defense.

## Description

Cadets and midshipmen are recruited through their respective military ROTC detachments and units on a national and regional level. Additionally, a Web site is available to allow any ROTC cadet or midshipman to apply electronically, similar to any university student applying to the Critical Skills Internship Project. An ROTC intern brochure was designed in FY01 and is continuing to be distributed nationally.

ROTC cadets and midshipmen must apply for internships before March 15 by using the CSIP Web site (<http://internships.llnl.gov/rotc>). Applicants are referred to individual researchers based on the applicants' academic credentials, expressed interest, grade point averages, and status as members in good standing at academic institutions and the ROTC. Researchers are encouraged to contact students to discuss potential projects and assess each student's skills and interest. When a

match is identified between a student and a researcher, an official application and a security questionnaire are sent to the candidate. Once the application, security questionnaire, and transcript are received, a "request to hire" form is processed along with the security-clearance application (which typically takes about six weeks to process). After the entry clearance has been authorized, reciprocity can be initiated to transfer the cadet or midshipman's DoD secret clearance to an LLNL DOE "L" clearance. At this point, the student can be brought into the Laboratory to begin his or her assignment.



*An Army ROTC intern*

In the meantime, LLNL researchers are encouraged to maintain contact with their candidates by forwarding literature via the mail or through Web sites. This allows the

students to come up to speed in their areas of research and to begin feeling like part of the research teams.

## Partners

### Laboratory

- Defense and National Security Office within LLNL
- Los Alamos National Laboratory
- Sandia National Laboratories, New Mexico and California
- Oak Ridge National Laboratory
- Idaho National Environmental and Engineering Laboratory

### Non-Laboratory

- California Maritime Academy
- The Citadel
- U.S. Air Force ROTC
- U.S. Military ROTC
- U.S. Naval ROTC
- Virginia Military Academy

## Objectives

- As stated by the Deputy Associate Director, Military Affairs, National Security Office, “Today’s cadets and midshipmen are the next generation of leaders for their respective services. What they learn at a DP lab will help shape their future ability to understand the broader defense capabilities of the country—including those that reside at Lawrence Livermore National Laboratory.”
- Establish a pipeline for recruitment following military commitment or retirement.
- Expose cadets, midshipmen, and graduates to military research at LLNL.
- Facilitate civilian and military faculty research collaborations.
- Ensure that cadets and midshipmen benefit from the technology experience, learned techniques, networking, publications, and exposure to issues of national defense.

## FY02 Accomplishments

- Hosted 81 cadets, midshipmen, and officers for ROTC Day on February 26, 2002.



*ROTC internships recruitment poster*

## FY02 Accomplishments *continued*

- Designed an ROTC internship recruitment brochure and distributed it through the Army, Navy, and Air Force ROTC.
- Recruited eight ROTC interns for the summer of 2002, and hosted two returning ROTC interns from the previous summer. In addition, one ROTC student from the summer of 2001 was scheduled to begin his graduate program late in the summer of 2002, so he spent a year on assignment at the Laboratory before entering graduate school. Overall, there were 11 ROTC interns at LLNL in FY02.
- Provided NIF and plutonium facility tours during the ROTC briefings to allow all participants to experience the facilities.
- Expanded the briefings to twice weekly to capture more DoD/military projects, including overviews of DTRA, NNSA, and STRATCOM.
- Offered a weekend (one-day) calm-water rafting trip, which became a highlight of the civilian experience.

## Evaluation/Assessment

The majority of participants were surprised to have their own offices, and all recognized the benefits of networking. When ROTC interns were asked how their research related to their backgrounds, a typical response was “It was challenging enough to intrigue me into wanting to learn more so I could understand it better, but not so hard that I was lost. I think I’d like to go to grad school.” When asked about supervisor relationships, one cadet said, “My supervisor is what made this summer such an outstanding experience—he even gave me a bicycle to use for two months while I was here.” When asked about the directions provided by their supervisors, another cadet said, “The directions for my project were clear but not necessarily specific, which turned out to be a good thing. This gave me leeway to take the project in my own direction and learn a great deal in the process.”

Participants learned or refreshed their skills in using software programs (e.g., Word, Excel, Unix, Linux) and gained project-specific skills. In addition, when asked how the research experience had influenced their military-career interests, a typical response was “I feel that it is too early to say what I want with my military career at this point, but this experience had definitely given me a lot more to think about.”

When asked about networking, one intern responded, “I got to be good friends with my roommates. I plan to see them sometime next year. I also plan to keep the phone numbers of the senior officers and scientists at the Lab in case I need to reach them.”

In summary, one ROTC cadet’s closing statement best exemplifies the value of the program to a ROTC intern: “This program is amazing. I learned more this summer than I did [by] taking a year’s worth of organic chemistry. The difference was the environment. Being engulfed in a scientific community fostered my desire to learn and ignited my curiosity about the infinite chemical and biological applications in our world. Being adopted into such an ambitious and scientifically creative atmosphere instilled in me a sense of enlightened work ethic...a

self-motivated pursuit of knowledge, rather than the mindless regurgitation of facts that still plagues most college students. And while funding scientific breakthroughs is still important, the absolute best investment for national security is exposing my generation to the technologies we are responsible to continue when America's future is in our hands."

## Military Academic Research Associates ROTC Day

URL: <http://step.llnl.gov/mara/rotc/>

The 5th annual ROTC Day took place on February 26, 2002. All California ROTC detachments and units were invited to participate in the event. Approximately 81 cadets, midshipmen, and officers attended.

The Laboratory's ROTC Day continues to be a part of the National Security Office's efforts to strengthen the relationship between Livermore and DoD. LLNL and STEP are helping to shape the future workforce by leveraging the rich scientific and technical base of the Laboratory. ROTC Day is a component of the ROTC internship project, where cadets and midshipmen spend internships at national-security laboratories (Lawrence Livermore, Los Alamos, and Sandia). The project has expanded to include Oak Ridge National Laboratory and the Idaho National Engineering and Environmental Laboratory. The ROTC internship project, a spinoff from the MARA program, provides hands-on internship research opportunities to undergraduate cadets and midshipmen. The ROTC internship project also offers opportunities to conduct thesis research and faculty research appointments.

Based on the success of past years, the ROTC Day included a panel discussion on future careers in the military and the roles that science and engineering play in these careers. This year's panel included General Haeckel, Jay Davis, and Ron Lehman. After the panel discussion and additional presentations on LLNL DoD/military research, participants went on one of the following tours:

- Tour 1: High Explosives Applications Facility and NIF
- Tour 2: Chemical and Biological Nonproliferation Program, DoD Technologies, and a mini-tour of NIF
- Tour 3: Conflict Simulation Lab, including the Joint Conflict and Tactical Simulation model; the National Atmospheric Release Advisory Center; and a mini-tour of NIF

Information on this year's ROTC Day, including the invitation, agenda, registration, tours, tour descriptions, and biographies of panel members, can be found on the LLNL ROTC Web site (<http://education.llnl.gov/mara/rotc>).



## Section 3: Science Outreach (K–12 Students), K–14 Education (Teachers), and the Edward Teller Education Center

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**URL:** <http://education.llnl.gov/>

### Introduction

STEP leads the Laboratory's science-education activities through science outreach to K–12 students and K–14 teacher education by

- enlightening K–12 students about college opportunities that will prepare them for future careers in science and technology, especially those of special interest to LLNL (see page 69);
- partnering with local, regional, and state K–14 educators to leverage the Laboratory's science and science-education programs to help contribute to the quality of science teaching in California (see page 77); and
- collaborating with UC Davis and UC Merced to create the Edward Teller Education Center at the UC Davis Department of Applied Sciences adjacent to LLNL (see page 88).

STEP's science-education and educator partnerships are supported with funding from the LLNL general and administrative distributed budget. Additional science-education information can be acquired at the following Web sites:

- STEP home page <http://education.llnl.gov>
- STEP educator resources [http://education.llnl.gov/step\\_educator.html](http://education.llnl.gov/step_educator.html)
- STEP education outreach [http://education.llnl.gov/step\\_outreach.html](http://education.llnl.gov/step_outreach.html)

During FY02, STEP's science-outreach and educator projects engaged approximately 13,000 students and 1,000 teachers.

Science Outreach (K–12 Students)	Number of Participants
California State Summer School for Mathematics and Science	30
Crystals for the Classroom	90
Expanding Your Horizons	983
Explorer Post	10
Exploring Your Future Conference	360
Fun With Science	8,980*
Future Scientists and Engineers of America	75
Math Challenge	100
Science on Saturday	1,700*
Student Research Academy	25
Tri-Valley Science and Engineering Fair	272
<b>Total</b>	<b>12,625</b>

\*Teachers, parents, and students



<b>FY02 K–14 Education (Teachers)</b>	<b>Number of Participants</b>
Computer Technology Workshops	200
Crystals for the Classroom	2
Educational Partnerships	100
Edward Teller Science Education Symposium	125
Faculty Research Experiences	4
Great Explorations in Math and Science	72
Groundwater Monitoring and Assessment Program	60
Laser Science and Optics in the Classroom	20
Promoting Achievement Through Hands-On Science	320
Teacher Research Academy	10
University of California/Community College/Central Valley Education	120
Web Tech Academy	19
Total	1,052

## Science Outreach (K–12 Students)

### California State Summer School for Mathematics and Science

URL: <http://www.cosmos.ucdavis.edu/>

#### Purpose

The California State Summer School for Mathematics and Science (COSMOS) was established by the California State Legislature to motivate the most creative minds of the new generation of prospective scientists, engineers, and mathematicians, who may become future leaders of California, the nation, and the world. The program is designed to create a community of students who participate in an intensive academic experience delivered by distinguished educators, scientists, and researchers.

#### Description

COSMOS is an academic, four-week residential program for talented and motivated students who are in grades 8–12. STEP collaborates with the UC Office of the President and UC Davis to provide COSMOS students with hands-on science activities at LLNL.

Each COSMOS student's schedule is built around a cluster consisting of two or three science- or math-based courses and a science-writing or communications course. On a typical day, COSMOS students attend special lectures, take courses, or participate in labs or course-related field trips. Recreation and study groups are built into the evening and weekend schedules, while special activities and supervised field trips are planned for the weekends. Social and cultural events and friendly competitions, including dorm Olympics, have been popular in the past. Other highlights include evening activities, such as COSMOS Jeopardy, dance lessons, and a student-organized talent show.

STEP collaborated with UC Davis to provide the 30 students in the optics cluster with hands-on experience in science areas at the Laboratory. The students visited Livermore one day per week for four weeks. On each visit, students participated in a workshop conducted by LLNL scientists



*An LLNL scientist conducting a hands-on workshop for COSMOS students*



*A Crystals for the Classroom student using the LLNL-donated prototype crystal-growing chamber*

in one of four science areas: radiocarbon dating, optics, biotechnology, and groundwater monitoring and vulnerability assessment. Each presentation featured hands-on learning activities and was followed by a tour of the research facilities corresponding to the instruction.

## Partners

- Edward Teller Education Center
- UC Office of the President
- UC Davis

## Objectives

- Broaden students' understanding of science and how it is used to solve problems.
- Provide hands-on activities to make students' exposure to science more interesting.

## FY02 Accomplishment

- As a result of the positive initial visit of COSMOS students to the Laboratory in 2001, two UC Davis COSMOS cohorts visited LLNL each week of the four-week program in 2002.

## Crystals for the Classroom

URL: <http://education.llnl.gov/crystals>

A high school chemistry teacher in the San Ramon Valley School District has integrated the growth of potassium dihydrogen phosphate (KDP) crystals into her regular and advanced placement chemistry curriculum. This hands-on application of chemistry provides students with experience in solution chemistry and assists them in developing laboratory skills that are essential for success in higher levels of chemistry.

## FY02 Accomplishment

- Using equipment provided by LLNL, students were able to grow KDP crystals that measure 9 centimeters on each side in five days.

## Expanding Your Horizons

URL: <http://www.llnl.gov/eyh/> and <http://education.llnl.gov/eyh/>

The one-day Expanding Your Horizons (EYH) conferences are designed to encourage young women in grades 6–12 to consider careers in math- and science-related fields. EYH depends on volunteers to plan and stage the conferences and serve as enthusiastic role models. The EYH conferences offer hands-on activities and promote the importance of science, mathematics, engineering, and technology. Two of the annual conferences supported by the Laboratory in partnership with other sponsors are conducted in areas with large populations of underrepresented students. EYH places a heavy emphasis on encouraging the conference participation of these students.

### FY02 Accomplishments

- During the 2002 academic year, LLNL supported three EYH conferences: the San Joaquin conference at the University of Pacific, the Tri-Valley conference in San Ramon, and the Merced conference at Merced College.
- The EYH conference for students in Alameda County, which is traditionally held at Mills College, was cancelled in 2002 due to a lack of volunteers. Mills College is planning to hold an EYH conference in March 2003.

EYH Conference	Attendees in Grades 6–12	Adult Volunteers
San Joaquin	263	127
Tri-Valley	570	345
Merced	150	4
Total	983	476

### Explorer Post

The Science and Technology Explorer Post 957 is chartered by STEP at LLNL under the Learning for Life organization (<http://www.learning-for-life.org>). The goal of the program is to encourage high school student members to stay focused on pursuing a college education by providing opportunities for them to work on projects related to their areas of study and interest.

### FY02 Accomplishments

- The LLNL Science and Technology Explorer Post met monthly with a program of speakers from within the Laboratory on subjects ranging from laser optics to astrophysics.
- In May 2002, students from the Explorer Post presented a biology project on the protection and management of the endangered red-legged frog during an Open House at the Laboratory Discovery Center (the former Visitors Center).
- In July 2002, Livermore's Explorer Post 957 joined students from another Science and Technology Explorer Post (sponsored by Bechtel Engineering and the Army Corps of Engineering in San Francisco) for a tour of the New United Motor Manufacturing, Inc. automobile assembly plant in Fremont.

## Exploring Your Future Conference

URL: <http://www.merced.cc.ca.us/mcti/future/>

The Exploring Your Future Conference was offered at Merced College to promote student interest in post-secondary education in science, math, and engineering. The conference targeted students in grades 6–12 and provided them with hands-on experiences that illustrated a variety of engineering disciplines.

### FY02 Accomplishments

- STEP participated as a conference partner by providing 15 science presenters from LLNL to conduct student workshops.
- 360 students attended the conference in April 2002.

## Fun With Science

URL: <http://education.llnl.gov/fws/>

The Fun With Science (FWS) program offers engaging, hands-on, standards-based science demonstrations for students, teachers, parents, and public groups. These demonstrations focus on chemistry, physics, changes of state, gases, pressure, and environmental-science activities. FWS activities are conducted by numerous LLNL volunteers from various scientific disciplines and are held in schools and in conjunction with science events throughout the Livermore area, the Central Valley, and the foothill counties of California.

The FWS program addresses requests from educators and the public for science-related presentations in the classroom and at community events. In particular, FWS introduces participants to the ways in which science and technology play significant roles in their lives. In addition, FWS activities encourage students to become more interested in and curious about science.



Laboratory volunteer Elvis Spencer pours liquid nitrogen during a Fun With Science presentation.

FWS has been adopted by the LLNL Public Affairs Office as an ongoing activity to be presented to local schools at the Laboratory's Discovery Center (the former Visitors Center).

### FY02 Accomplishments

- Demonstrations were presented to 8,980 teachers, students, and parents during the school year.
- More than 50 LLNL employees participated as FWS presenters.

## Future Scientists and Engineers of America

URL: <http://www.fsea.org/>

Future Scientists and Engineers of America (FSEA) is a national nonprofit organization that provides the structure, project materials, documentation, and workshop training necessary to establish after-school technology clubs. FSEA encourages individual scientists to mentor a classroom of students (grades 4–12) on an FSEA project chosen by the scientist.

### FY02 Accomplishments

- STEP supported three FSEA after-school science clubs at two schools within the communities surrounding LLNL. In each club, a Laboratory technical employee acted as the advisor, and a teacher served as the official contact with FSEA.
- 75 students at the two schools chose FSEA club involvement as an extracurricular activity.
- There was a measurable improvement in the statewide testing scores among the 50 FSEA student participants at one of the schools.

## Math Challenge

URL: <http://education.llnl.gov/mc/>

Math Challenge, an event cosponsored by STEP and the U.S. Department of Energy's Oakland Operations Office, is designed to encourage students' interest in math. The event also seeks to support the 1989 Governors' Summit goal of making U.S. students first in the world in science and mathematics. Each school may send up to five teams of three students to participate in Math Challenge. The first-, second-, and third-place teams receive plaques honoring their achievement, while individual participants receive certificates of participation.

### FY02 Accomplishments

- The 13th annual conference was held at LLNL in May 2002.
- An estimated 100 students and five Laboratory employee volunteers participated in a series of math activities that used puzzle solving as the basis of student learning.

## Science on Saturday

URL: <http://education.llnl.gov/sos/>

### Purpose

The purpose of the Science on Saturday (SOS) program is to allow students to interact with well-known scientists and engineers. SOS also has a long-term goal of increasing the number of students who pursue careers in science and technology.



*The audience at one of the five Science on Saturday presentations in FY02*

## Description

SOS presents a series of free lectures and demonstrations for students in grades 6–12. SOS topics are selected from the forefront of science and technology research at LLNL in a variety of disciplines. During 2002, Laboratory scientists presented lectures on the following topics:



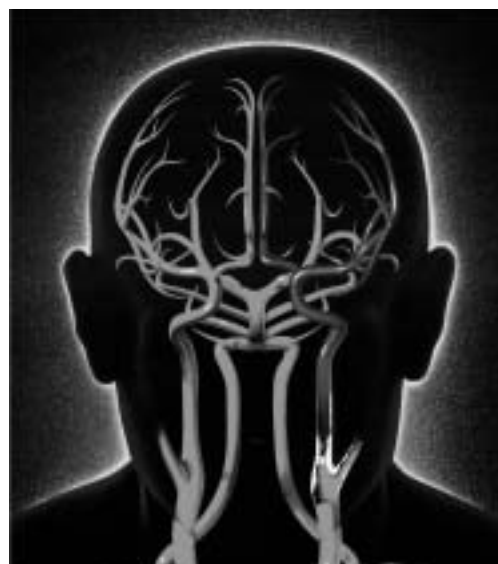
*Pillars of dust and gas from the Eagle Nebula*

### ***Pillars of the Eagle Nebula—Can We “Make” Celestial Objects Using Lasers?***

Students learned that radiation from bright, young stars thousands of light-years from Earth is causing distant pillars to be formed from the Eagle Nebula, a cloud of dust and gas. The speaker explained that studying these pillars may provide hints about the origins of Earth because stars and planets are formed out of clouds similar to the Eagle Nebula. Students learned about modern tools (e.g., the Hubble Space Telescope, computer simulations, and the world’s largest lasers) that are being used to test various theories about the pillars. The lecture ended with a description of the National Ignition Facility and its potential for helping scientists understand the origins of the universe.

### ***Brain Attack—New Technologies for Treating Strokes***

This presentation taught students about blood flow to the brain, types of strokes, aneurysms, and hematomas. Students also learned to identify the symptoms of a stroke and why they should treat strokes as “brain attacks,” time-critical emergencies that require prompt treatment to save lives and reduce disabilities. The lecture described several systems developed by the Laboratory’s Medical Technology Program to detect and treat strokes and other circulatory-system diseases in the head. Students also learned about current stroke treatment and new treatment possibilities, including LLNL-developed technologies such as photoacoustic thrombolysis.



*The circulatory system in the human brain*

### ***Robots—Look Out! We’re Surrounded***

This lecture introduced students to the world of robots. Students were exposed to the many different shapes, sizes, and colors of robots and the types of work that robots can perform. Students learned the definition of a robot and how to identify and categorize robots of varying complexity. Students also explored careers that may provide them with opportunities to work in the field of robotics.

### ***Volcanology—Volcanoes in Your Backyard***

This presentation invited students to explore the volcanic wonderland within California. Students were introduced to plate tectonics theory and how this theory accounts for the development of California’s volcanoes. Students learned to identify different volcanic features and where to find specific examples within a short drive of Livermore. The lecture also addressed the volcanic hazards associated with each of California’s volcanoes in the context of the volcano’s historic activity and anticipated future activity. Students were also exposed to the history of volcanology and some of the unanswered questions presented by California’s volcanoes.

### ***How Galaxies Are Formed—Starbursts Forever***

Students learned how galaxies and stars form. The lecture explained some basic concepts that are used by astronomers in Earth- and space-based observatories to understand the physical processes in objects billions of light-years away. Students saw how stars are born in large groups, or “starbursts,” inside the cold, interstellar clouds of galaxies; how stars die; how galaxy collisions trigger the most dramatic starbursts of all; and how these starbursts build larger galaxies and may trigger active, super-massive black holes. The lecture provided examples of ongoing research and development at LLNL in instrumentation and observing techniques. The lecture also described the importance of detailed computer simulations for interpreting astronomical observations.

## **Partners**

- The LLNL Chapter of Sigma Xi, the Scientific Research Society
- Edward Teller Education Center



## Objectives

- Provide students, teachers, and the community with insights into current LLNL activities.
- Develop participants' awareness of the connection between scientific-research topics and science taught in the classroom.
- Enhance classroom instruction by helping science teachers develop background knowledge.

## FY02 Accomplishments

- Five SOS lectures were presented in FY02. The average participation rate increased from approximately 350 to 400 per session.
- An estimated 1,700 students, parents, and teachers participated in SOS.

## Student Research Academy

URL: <http://education.llnl.gov/sra/>

### Purpose

The purpose of the Student Research Academy is to prepare students to conduct self-guided research investigations.

### Description

During this summer academy, students learn how to conduct research studies to answer scientific questions of their choosing. Students participate in hands-on activities that are designed to develop their understanding of the research process. In addition, students explore a variety of research topics through discussions with LLNL researchers and tours of their laboratory settings. Students also learn how to use a science library to conduct background literature searches and how to use software and computer technology to record and analyze research data. Students present their finished research findings in a poster format at a symposium to their peers, teachers, and research professionals. Students also publish their findings in a student research journal.

### Partners

- Several LLNL Directorates, including Energy and Environment and the Biology and Biotechnology Research Program
- Edward Teller Education Center

## Objectives

Students will learn to

- apply the research process to answer research questions of their choosing,

- use computer technology to collect and record research data,
- present their research findings in a poster format at a symposium, and
- prepare a research paper discussing their findings.

## FY02 Accomplishment

- Twenty-five students completed the academy.

## Tri-Valley Science and Engineering Fair

URL: <http://tvsef.llnl.gov/>

The Tri-Valley Science and Engineering Fair (TVSEF), an affiliate of the Intel International Science and Engineering Fair (Intel ISEF), is a science-project competition for students in grades 7–12 from public schools within Danville, Dublin, Livermore, Pleasanton, San Ramon, and Sunol. The STEP director has been the committee chair of the TVSEF Science Review Board since its inception. The winners of the TVSEF are eligible to compete in the Intel ISEF (<http://www.sciserv.org/isef>), the world's largest pre-college celebration of science that brings together over 1,200 students from 40 nations each May.

## FY02 Accomplishments

- More than 342 students submitted projects to the 6th Annual TVSEF in 2002.
- Of the 342 submitted projects, 272 were chosen to participate in TVSEF (this number was determined by the maximum capacity of the TVSEF location at the Blackhawk Museum in Danville).

## K–14 Education (Teachers)

### Computer Technology Workshops

URL: <http://education.llnl.gov/technology/>

#### Purpose

This Computer Technology Workshops prepare teachers to effectively use (1) the Web as a resource to improve the quality of their instruction, (2) their schools' Web resources, and (3) a variety of multimedia tools as teaching resources.

#### Description

These hands-on workshops teach educators to use computers and the Web. Participants spend most of their workshop time applying what they have learned to develop materials and resources



they can use in their classrooms. Teachers can choose to learn on either Macintosh or PC computers so that they can gain experience on the type of computers that is most readily available at their schools.

Participants learn how to locate teaching resources online and how to guide their students to Web resources. Teachers also learn to use classroom Web sites to provide students with information about assignments, improve communication with parents, and enhance teacher-to-teacher collaboration.

Participants register online for workshops. Workshops are provided at various skill levels, from beginning to very experienced. The workshop classes are divided into four areas:

- Computer Workshops
- Accessing Web Resources Workshops
- Web Development Workshops
- Presentations Workshops

**Computer Workshops** help participants understand computer operating systems. Novice computer users learn about basic computer components, miscellaneous peripherals, and related extensions and preferences. More experienced users are trained to troubleshoot problems and optimize their computers. Participants in the advanced class learn how to manage multiple Macintosh computers in their classrooms.

**Accessing Web Resources Workshops** teach participants to use resources on the Web more effectively. Novice Internet users can learn how the Internet works, how to connect to the Internet, and how to configure and use a Web browser. A more advanced workshop trains educators to use advanced information-searching techniques on the Web, evaluate the validity of Internet resources, and apply copyright laws to the classroom use of information found on the Web.

**Web Development Workshops** prepare teachers to publish information for others to use. Participants in the basic course learn to use text editors, Microsoft Word, and HTML editors to create simple Web pages. An intermediate workshop trains participants to create Web pages that effectively communicate information to a targeted audience. Advanced courses cover topics such as building dynamic Web pages, developing Web sites, and using Adobe Photoshop to prepare Web images.

**Presentations Workshops** show teachers how to create dynamic presentations using Microsoft PowerPoint. Such presentations can reduce the amount of time needed to write information on the board and can create opportunities for integrating multimedia tools into classroom lectures.

## Partners

- Edward Teller Education Center
- California Technology Assistance Program, Region 6

## Objectives

Participants will learn to

- effectively use their computers to support classroom instruction,

- more effectively use their schools' Web resources,
- locate teaching resources online,
- build their own Web pages, and
- develop multimedia presentations.

## FY02 Accomplishments

- During FY02, 12 workshops were held between June and August. Each workshop accepted 20 teachers, with 200 actually completing the instruction.
- Twenty-five participants earned academic credit from the University of San Diego. Their work was evaluated for a letter grade as evidence of their skill development.

## Crystals for the Classroom

URL: <http://education.llnl.gov/crystals/>

### Purpose

The purpose of the Crystals for the Classroom program is to improve high school and college chemistry teaching and student learning so that students will be drawn toward the study of chemistry instead of avoiding it. Specifically, this program is designed to help students learn basic chemistry principles and develop laboratory and critical-thinking skills through answering research questions and addressing goal-based challenges.

### Description

The Crystals for the Classroom program maintains a student-centered, team-based learning strategy that embeds the principles of solution chemistry and analytical chemistry into a teaching–learning methodology representative of actual research. In this program, students use a cutting-edge, rapid-growth technology to grow KDP crystals, which are similar to the crystals grown for the laser optics of the LLNL National Ignition Facility. The Crystals for the Classroom program has received special recognition for its contributions to science education.

The San Ramon Valley School District (SRVSD) collaborated with LLNL scientists to initiate the Crystals in the Classroom program and has determined that students benefit from this technology. In 1999, SRVSD funded a high school chemistry teacher to work in an LLNL research laboratory. The teacher learned to use the rapid-growth KDP crystal technology developed by Dr. Natalia Zaitseva, an LLNL consortium scientist and key advisor for this program, and contributed to the design of a prototype crystal-growing chamber for the classroom. LLNL then donated the prototype crystallizer to SRVSD and mentored the teacher as she integrated the crystal-growth process into her high school and advanced placement chemistry curriculum. The consortium scientists and science educators have demonstrated that this LLNL-developed, state-of-the-art crystal technology can be successfully transferred to high school classrooms.



During the 2001–2002 school year, high school chemistry students grew KDP crystals weighing approximately four pounds in five days. By growing these crystals, the students gained an understanding of how chemistry contributes to the creation of new materials and how to solve real-world problems. They also developed skills and knowledge required by the California Chemistry Content Standards for grades 9–12 for basic chemistry concepts and topics, such as the chemical and physical properties of matter and chemical equilibrium. The students also learned the following key chemistry concepts:

- Conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.
- Solutions are homogenous mixtures of two or more substances.

The Crystals in the Classroom program is being extended to include community college chemistry students. These students will use the original LLNL experimental crystal-research data to develop their understanding of solution chemistry. The students will also test the starting solutions using atomic absorption spectroscopy and wet-bench methods and then post their analytical results on the Web.

The Crystals for the Classroom Web site has been designed to introduce students to the chemistry of crystals and solutions. Lessons in chemistry are embedded in issues relating to energy production, the science of nuclear energy, and the frontiers of research in nuclear fusion. The Web site provides a collection of student–teacher materials for college general chemistry instructors that serve a wide range of pedagogies. The materials are intended to stand alone in most cases and do not require the adoption or use of an entire module. Aspects of the modules are suitable for high school chemistry and are adaptable for science fair and research projects.

## Partners

- A consortium of science educators and research scientists, including LLNL scientists and chemistry faculty from SRVSD, Diablo Valley College, and Contra Costa College, that aims to develop science and technology instructional tools for chemistry teaching
- Edward Teller Education Center
- The Camille and Henry Dreyfus Foundation

## Objectives

- Educators will integrate the rapid-growth technology into chemistry instruction.
- Students will become proficient in high school chemistry and laboratory skills by growing crystals.
- Students will connect the basic concepts of chemistry to real-world applications, visualizing the relationship between classroom instruction and actual applications.
- Students will learn to use the research process. Students will apply research skills while conducting student-centered research projects. Students will make connections and explore complex issues requiring critical thinking.

## FY02 Accomplishment

- Received a grant from the Camille and Henry Dreyfus Foundation to develop the Crystals for the Classroom Web site.

## Educational Partnerships

Educational partnerships represent activities that are cosponsored by STEP and at least one outside education institution. In most cases, these activities are either workshops or tours held at LLNL for educators, or workshops at educational institutions where STEP has helped with presentations and/or presentation materials.

## FY02 Accomplishment

- STEP highlighted its education activities and the Laboratory's research at a significant partnership event, the Educator Day at LLNL. The event was presented collaboratively with Merced College in June 2002. Approximately 100 education administrators and several California legislators representing the San Joaquin Valley attended this event. They received an overview of LLNL and the educational resources available for teacher professional development, as well as student enrichment activities at LLNL. The participants toured four research facilities: the Center for Accelerator Mass Spectrometry, the optics laboratories, the National Atmospheric Release Advisory Center, and the Edward Teller Education Center.

## Edward Teller Science and Technology Education Symposium

URL: <http://education.llnl.gov/symposium2002/>

### Purpose

The purpose of the Edward Teller Science and Technology Education Symposium is to act as a bridge between the science classroom and the research laboratory by providing science educators from secondary schools and community colleges with the opportunity to explore ongoing research at LLNL in physics, chemistry, biology, environmental science, and radiation science.

### Description

During the symposium, LLNL researchers share cutting-edge science and technology with secondary and community college science educators. Educators receive state-of-the-art science information, take-home lessons, and activities to be used in the classroom. The lessons and activities are directly linked to the California Science Education Standards. Examples of activities presented at previous symposia are available on the STEP Web site (<http://education.llnl.gov/symposium2002/>).

In FY02, 125 science educators from schools and colleges throughout California participated in the symposium. Based on their teaching interests, participants were assigned to one of five content



*The Bio-Rad Biotechnology Explorer kit*

groups: physics, chemistry, biology, radiation science, or environmental science. During the symposium, the participants toured state-of-the-art laboratories at LLNL related to their teaching interests and talked to scientists in these laboratories about their research. Participants also listened to an address from Dr. Edward Teller and enjoyed a “Dinner with a Scientist” event. During the dinner event, participants learned about current science and technology applications from a nationally recognized keynote speaker.

Each participant also attended three hands-on workshops to learn new classroom activities. Lessons and activities for each of the content themes are described below. In addition, each participant was given a set of materials to use in the classroom. The set contained explanations about the activities and slides from the workshops. Copies of a CD-ROM, with images of the laboratory facility tours and all workshop materials, were also distributed to participants.

### ***Biology Focused on Biotechnology***

This group explored various processes of recombinant gene expression and protein purification. Participants used Bio-Rad Biotechnology Explorer kits to isolate the Green Fluorescent Protein and analyze protein gels of samples that were purified via column chromatography.

### ***Environmental Science Focused on Radiocarbon Dating***

Participants learned the basics of radiocarbon dating. They participated in problem-solving activities where they interpreted actual carbon-14 data sets from volcanic eruptions and earthquake faults to determine the dates of past eruptions and earthquakes.

### ***Chemistry Focused on Groundwater Monitoring***

Group members studied groundwater contamination and learned how to use age dating to track the formation and movement of groundwater. Participants also carried out a hands-on exercise using data from the Alameda Creek watershed; this exercise showed how surface water infiltrates the ground to become groundwater.

### ***Physics Focused on Opto-Electronic Technology***

Participants learned how the merging of developments in optical physics and materials science created the optical revolution in communication, the ability to transfer information at the speed of light. Group members completed hands-on exercises in polarization, built polariscopes, and applied their knowledge to understand how liquid crystals are used in communication.



*Science educators learn about groundwater monitoring.*

### ***Radiation Science***

Group members learned about different types of radiation in the world and the uses and benefits of radiation. They also explored sources of naturally occurring radiation and used computers to visualize and measure background radiation. In addition, participants learned about acceptable radiation doses and how to detect and measure radiation with a Geiger counter.

## Partners

- Edward Teller Education Center
- UC Davis Department of Applied Science,
- The LLNL Chapter of the Sigma Xi Research Society
- American Nuclear Society
- The Seaborg Institute
- Optical Society of America

## Objectives

Participants will

- gain new content knowledge,
- learn to use new lessons to explain this new content information,
- add scientists and science teachers to their network of resources, and
- experience how science is applied to solve problems.

## FY02 Accomplishments

- 140 secondary-education and college educators registered for the symposium, and 125 educators attended.
- All participants who responded to the program evaluation survey thought that the materials were outstanding and that the program was well worth their time.
- Nearly 75 percent of the participants said they would use the materials within 30 days of returning to school.

## Faculty Research Experiences

Faculty members from Merced College and Modesto College participated in LLNL research in biotechnology, in geographic information systems, and at the Center for Accelerator Mass Spectrometry. The colleges funded these internships to help faculty members renew their content knowledge. As a result of their research experiences, the faculty members incorporated changes in their curriculum that reflected their exposure to innovations in technology and procedures at the Laboratory.

## Great Explorations in Math and Science

Great Explorations in Math and Science (GEMS) curriculum units from the Lawrence Hall of Science are used in the following three STEP science-education activities:

- Fun With Science
- Promoting Achievement Through Hands-On Science
- Science on Saturday



STEP offered science-curriculum-unit workshops to fourth- to eighth-grade teachers who attended the SOS lecture series. Four of the five SOS lectures in FY02 were followed by teacher workshops. Each workshop described how to implement a GEMS unit corresponding to the SOS topic in the classroom. Workshop participants were given the teacher's guide to the GEMS unit and the materials to teach the unit to their students. The materials provided teaching strategies and hands-on science activities to help students further explore the science content presented in the SOS series. Teachers who attended the four SOS lectures and workshops could apply for college-course credits through Fresno Pacific College.

In addition, the scientists who spoke during the SOS lectures met with the teachers after the lectures to answer questions and provide additional scientific background information. Resources and support for the GEMS training were provided through a collaborative effort between STEP and the San Joaquin County Office of Education.

## FY02 Accomplishment

- 18 teachers participated in the GEMS training at each of the four sessions.

## Groundwater Monitoring and Assessment Program

### Purpose

The Groundwater Monitoring and Assessment Program (GAMA) aims to introduce teachers to groundwater monitoring so that they can incorporate the subject into their science curriculum and raise community awareness of water issues.

### Description

GAMA is a teacher professional-development program that encourages teachers to incorporate groundwater monitoring into their classroom curriculum. The program trains teachers to use the GAMA curriculum and provides them with needed resources. The program has also partnered with the California State Water Resources Control Board to provide resources to Tri-Valley Regional Occupational Program students in environmental science and technology as they study groundwater monitoring. Since this is a statewide project, teachers and their schools are ideal community conduits for local input and public education. This model of incorporating teacher/educational institution input with national laboratory and local business agency missions will be taken to the Merced, Stanislaus, and Tuolumne county areas.

### Partners

- Edward Teller Education Center
- Tri-Valley Regional Occupational Program
- California State Water Resources Control Board
- LLNL Analytical and Nuclear Chemistry Division

## Objectives

- Integrate groundwater-related data and concepts into core subject areas: geography, history, English, and science.
- Help establish distance-learning and video-conferencing capabilities.
- Provide Web-based and hands-on continuing professional networking for teachers and the community.
- Include teachers and administrators of grades 6–12 in planning and implementing professional-development activities.
- Provide support technology and training for teacher instruction.

## FY02 Accomplishment

- Additional workshops based upon the GAMA curriculum were incorporated into the Edward Teller Science and Technology Education Symposium and the COSMOS program. The symposium experience provided instruction to teachers of grades 6–14. The COSMOS program reached students in grades 9–11.

## Laser Science and Optics in the Classroom

URL: <http://education.llnl.gov/LSOC/>

### Purpose

The purpose of the Laser Science and Optics in the Classroom (LSOC) program is to introduce optics as a resource to support existing instruction across science disciplines and in mathematics.

### Description

The LSOC program provides an extension to physical science instruction at the high school level. The program initializes a school-to-career path leading to careers in laser science and optics. Teachers participating in LSOC receive materials and lessons to help them integrate laser and optics technology into high school science and mathematics curricula. LSOC lessons are activity-based, providing students with hands-on experience in using lasers and optics equipment.

### Partners

- Edward Teller Education Center
- Optical Society of America
- International Society for Optical Engineering
- LaserLight Lab, Inc.
- Tri-Valley Regional Occupational Program
- UC Davis Education Outreach



## Objectives

Participants will

- learn how a laser functions,
- conduct experiments and optics activities using the equipment in the LSOC materials kit, and
- learn how to integrate optics into existing instruction across science disciplines and in mathematics.

## FY02 Accomplishment

- During FY02, 20 teachers from middle schools in the Sacramento area attended an LSOC workshop. This professional-development workshop, which was offered in collaboration with the UC Davis Education Outreach program, prepared teachers to introduce optics into their existing curriculum to match the California State Science Standards.

## Promoting Achievement Through Hands-On Science

URL: <http://education.llnl.gov/paths/>

Through a partnership between LLNL, UC Merced, and the San Joaquin County Office of Education, the PATHS program provides a science-education outreach program to schools in the Livermore area and Central Valley counties.

The PATHS program brings the Laboratory's FWS program to schools. Students interact with scientists while experiencing hands-on science demonstrations in chemistry, physics, and environmental science. These interactions increase students' learning achievement and science awareness. Students become engaged, excited, and involved in science-education activities.

The PATHS program also encourages and prepares teachers to teach high-quality, hands-on, inquiry-based science units by training teachers at their school sites. Following each FWS presentation, teachers are trained in a school-selected GEMS unit from the Lawrence Hall of Science that is aligned with the presentation and California State Science Standards. Schools are then provided with the science kit and the materials needed to teach the unit in their classrooms.

## FY02 Accomplishments

- Liselle Clark, a visiting educator in STEP, provided after-school training to 320 teachers in 15 schools.
- More than 2,200 students in grades K–8 were directly impacted by the PATHS program.

## Teacher Research Academy

URL: <http://education.llnl.gov/tra/>

This program prepares science teachers to guide student research projects. The 10-day Teacher Research Academy (TRA) introduces teachers to the research process through a series of inquiry-based activities. Teachers explore research occurring at LLNL and meet with research scientists to discover many approaches to conducting research. Teachers also learn strategies to help them guide students in conducting self-directed research investigations. TRA is linked to the Student Research Academy; students attending the Student Research Academy must have a teacher who has completed the TRA or an equivalent program. TRA graduates can apply for research internships at LLNL when funding is available.

## University of California/Community College/Central Valley Education

### Purpose

The purpose of the University of California/Community College/Central Valley Education program is to support and promote student achievement in science and math education in the Central Valley through collaborative efforts with UC Merced and Merced College.

### Description

STEP has prepared a memorandum of agreement (MOA) linking UC Merced and Merced College with LLNL to share the science and technical resources and promote student achievement in science and technology. Several activities are carried out during the year to implement this MOA.

Educators and state legislative representatives from throughout the San Joaquin Valley participated in Educator Day at LLNL. During this day, participants attended presentations highlighting resources at LLNL that are available to support science instruction. Participants also visited several research laboratories to experience the “real science” from which these education resources are developed.

Merced College has continued to send faculty members to LLNL for sabbaticals. Faculty members have worked in the biomedical program participating in biotechnology research and in the Geographic Information Center mapping research data. These experiences have assisted faculty members in implementing a new biotechnology technician certificate program at Merced College and in preparing for a new certificate program in geographic information systems.

STEP also established a scientific-equipment loan program with Merced College. The equipment will be used to develop programs to train students in optics, biotechnology, and environmental science, as well as computer science technician programs.

### Partners

- Edward Teller Education Center
- UC Merced
- Merced College



## Objectives

- Increase student performance in science and technology education.
- Provide professional development for all K–14 teachers throughout their teaching careers.

## FY02 Accomplishment

- Received a \$50,000 grant from Washington Mutual Bank to support teacher professional development in California rural communities, such as the Central Valley.

## Web Tech Academy

URL: <http://education.llnl.gov/webtech/>

The Web Tech Academy (WTA) is a 10-day workshop that prepares teachers to develop Web sites to support their classrooms. WTA bundles together several sets of cumulative computer and Web technology skills and provides teachers with an opportunity to apply these skills as they create resource Web sites for their classrooms. WTA overcomes some of the problems associated with individual workshops, such as skill retention, by allowing time for teachers to both learn and use new Web skills. WTA participants received copies of the software they learned to use and earned academic credit for completing the academy.

## Edward Teller Education Center

URL: <http://etec.ucdavis.edu>

The Edward Teller Education Center (ETEC) is a University of California collaborative established to provide professional-development instruction in science and technology to K–14 teachers. ETEC was initially funded by the UC Office of the President and is operated by UC



*The construction of the Edward Teller Education Center building in Livermore*

Davis, UC Merced, and LLNL. ETEC's primary service area includes the San Joaquin Valley and the greater Livermore Valley. A 13-member board of directors representing the community served by ETEC, including community colleges, county offices of education, and school districts, oversees the operation of ETEC. The ETEC facility is located adjacent to LLNL at the Livermore campus of the UC Davis Department of Applied Science (DAS). ETEC programs are offered at the ETEC facility, at the campuses of member institutions, and at LLNL facilities. ETEC is managed by a director who is responsible for program implementation, evaluation, and fund-raising.

LLNL has funded the construction of a specialized laboratory classroom facility that is being built on the DAS Livermore campus. This facility will offer a complete wet-laboratory classroom and a computer laboratory.

In collaboration with STEP, ETEC offered a variety of professional-development programs in science and technology for teachers during FY02. These programs included public outreach activities to inform the community about ETEC and the collaboration that established the center. ETEC also provided science and technology enrichment programs for students.

The first director of ETEC, Stan Hitomi, was selected by the board of directors and was hired in March 2002. Stan is a high school biology and physical science teacher at Monte Vista High School in Danville, California. He has 20 years of teaching experience and has served as a mentor teacher for the San Ramon Valley Unified School District for the past eight years. Stan is currently a member of the Community Advisory Panel for the KQED television station and has worked on science-education projects with LLNL, UC Berkeley, the San Joaquin County Office of Education, WNET-New York, KQED-San Francisco, Access Excellence (Genentech), and the Exploratorium.



*ETEC director, Stan Hitomi*

While working with LLNL, Stan partnered with other teachers to coauthor the Biotechnology Education Program, Laser Science and Optics in the Classroom, and Research Bootcamp. Each of these programs focuses on teacher development and training, with a strong focus on integrated instruction. Stan currently serves on the Staff Development Leadership Council, a national organization with a mission to study, research, and develop staff-development programs. Stan was recently awarded a scholarship by the Carnegie Foundation for the Advancement of Teaching to conduct research on teaching methods and practices.

## FY02 Accomplishments

Oct. 2001	Was featured at the Rural Education Summit as a resource.
March 2002	Broke ground for the new ETEC classroom facility.
April 2002	Hired the first ETEC director.
April 2002	Conducted a needs assessment to identify and target the developmental needs of ETEC's constituent schools, teachers, and students as the basis for the ETEC strategic plan.
June 2002	Cohosted with STEP teacher professional-development and student enrichment programs in science and computer technology at the ETEC facility.
Sept. 2002	Cohosted with STEP the Edward Teller Science Education Symposium for 125 teachers from locations throughout California.
Oct. 2002	Received a grant from Washington Mutual Bank to provide rural teachers with professional-development opportunities at ETEC.



## Section 4: LLNL Institutional Education Activities

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### Introduction

STEP continues to take the lead in facilitating and piloting numerous educational initiatives at Lawrence Livermore National Laboratory. STEP leads the LLNL Institutional Education Committee (IEC), which combines efforts throughout the Laboratory to promote student activities. STEP also maintains a Web site (<http://www.llnl.gov/education>) that provides updates about LLNL opportunities for students and faculty. In addition, STEP is in its third year of helping students prepare for the Graduate Record Exam (GRE) by engaging Kaplan Associates to offer a GRE-preparation workshop and by acquiring a site license for the test-preparation software, GRE PowerPrep.

Working with the IEC, STEP offers all summer participants a schedule of seminars and tours, social activities, and a series of panel discussions. In addition, STEP provides an online Student Bulletin Board (SBB) (<http://step.llnl.gov/sbb>), which provides summer students with a networking mechanism; helps them learn about scheduled lectures, seminars, and social activities; and facilitates their interactions on a social level. Students can also use the SBB to access information about events and activities in the Bay Area region and beyond.

By using the SBB, interns can network with other registered summer students through a list server, arrange their own meetings, seek input from their peers, receive the latest updates on seminars that interest them, and be notified of any last-minute seminar times and locations. Students can even access information about scholarships through the SBB, which provides a link to the 2002 Colleges, College Scholarships, and Financial Aid Web site (<http://www.college-scholarships.com/>).

The FY02 summer students continued to offer positive feedback about the SBB (“I think the bulletin board is great—can’t think of any changes”) and suggestions to improve links or organization of the bulletin board. Generally speaking, students found the SBB useful for checking on the status of events and for registering online for tours and other events.

### Is an Undergraduate Education Sufficient?

As in previous years, a number of activities were offered in FY02 to motivate students to pursue graduate degrees. For example, students were able to download GRE PowerPrep for free, courtesy of a STEP-acquired site license, and could participate in a GRE pretest and feedback strategy session presented by Kaplan Associates.

The GRE is a computer-based exam that forces students to answer questions sequentially; unlike with paper exams, students cannot skip GRE test questions and answer them later. The programmed test offers harder or easier questions, depending on whether a student answers previous questions correctly or not. Through this process, the student’s knowledge is qualified to a set number, or GRE score.

The Kaplan GRE workshop addressed special test-taking strategies for the GRE. Students who participated in the feedback session considered the workshop to be very useful and informative in helping them prepare for the exam.

In an effort to dispel the many myths and misunderstandings about applying to and getting into graduate school, Dr. Collette Patt, director of the Physical Sciences Student Diversity Programs at UC Berkeley, offered a presentation about “Graduate School Myths” to the LLNL summer students. This is the third year that Dr. Patt has spoken to LLNL summer students about graduate school admissions. Student feedback regarding the presentation included the following:

- “I think that the session was fantastic. I feel like I learned a lot. I am sure that there are many things that I will learn in the process of applying to graduate school. But I really feel as if the whole presentation was a success. I certainly feel more confident about the application process.”
- “I thought yesterday’s presentation was very helpful. I had been exposed to virtually no information about grad school previously. Two valuable things that I walked away with were the shock that I can actually get paid to go to school and the fact that it is better to apply for a Ph.D program and quit early to get your master’s if you are unsure about getting a Ph.D, rather than applying to a master’s program and then later deciding to continue onto a doctoral program.”
- “It was really helpful. I had no idea there was so much funding available to pay for grad school. Dr. Patt probably saved my parents a lot of money!”

For the first time this year, questions and the answers from the panel discussions, “Graduate School Myths” discussion, and information sessions were compiled and shared with students via the SBB.

## LLNL Institutional Education Committee

LLNL employees representing each of their respective Laboratory organizations have pooled their limited and constrained resources to participate in a Laboratory-wide committee, the LLNL Institutional Education Committee, which is chaired and facilitated by STEP personnel. IEC members have provided input for the development of the electronic SBB and have facilitated various seminars, tours, brown bag lunches, socials, and panel discussions.

Recent participating organizations in the IEC include the following:

- Affirmative Action and Diversity Program
- Biology and Biotechnology Research Program
- Chemistry & Materials Science Directorate
- Computation Directorate
- Director’s Office
- Energy & Environment Directorate
- Engineering Directorate
- Environmental Protection Department
- Environmental Restoration Division
- Geophysics & Global Security

- Health & Ecological Assessment
- Human Resources
- Operations and Regulatory Affairs Division
- Physics and Advanced Technologies Directorate
- Science and Technology Education Program (lead organization)

Each summer, LLNL hosts approximately 300 to 400 students who support research projects across the Laboratory. Summer students range from a few exceptional high school students to undergraduate and graduate students. Because of this variety in age, discipline, and academic background, the committee recognizes that a broad program is needed to address the diversity of student interests. The IEC has pooled its resources to provide such a program.

Student research experience is highly valuable to both the Laboratory and to students. However, a summer at the Laboratory can still be a poor experience for students if they feel isolated. STEP works in partnership with the other IEC members to ensure that summer students feel supported and connected. As a result, STEP has received many positive comments from students about their summer research experiences, including the following:

- “I love working at LLNL! I would highly recommend it to anyone interested in research.”
- “I had a great experience and look forward to working with everyone next summer!”

## Student Bulletin Board

The Student Bulletin Board (<http://step.llnl.gov/sbb/>) offers lists of student-specific activities and lectures and provides information about scholarships and grants. The SBB also helps participants to network with one another or plan weekend activities.



*Summer students at the Searching for Dark Matters Axion seminar and tour*



*Summer students at the UC Davis Graduate Program Opportunities seminar*

In FY02, there were 34 scheduled events (meetings, seminars, tours, etc.) within the following major elements:

- GRE practice tests and feedback session
- Three classes on creating effective poster presentations for the LLNL Student Research Symposium
- LLNL Student Research Symposium
- Research: Methods, Manuscripts, and Money (three-part seminar)
- BBQ
- Ice cream social
- Searching for Dark Matter Axions seminar and tour (offered twice)
- Fast-Growth Crystal seminar
- Inside the Mind of a Terrorist seminar
- Graduate Admittance Myths & Discussions (three parts)
- National Ignition Facility (NIF) seminar and tour
- Malicious Code Dissection seminar
- Joint U.S./Russia Nuclear Nonproliferation Efforts seminar
- The Road to Root seminar
- SSPX Spheromak tour
- Exploring Environmental and Biomedical Sciences with Accelerator Mass Spectrometry (four tours of the Center for Accelerator Mass Spectrometry [CAMS])
- Tips for Successful Interviewing seminar
- Book signing with Dr. Edward Teller
- Combating Bioterrorism: Scenarios and Science seminar
- UC Davis Graduate Program Opportunities seminar
- Massachusetts Institute of Technology (MIT) Graduate Nuclear Engineering Opportunities seminar

- Advanced Simulation and Computing (ASCI) Alliance Information Session seminars (with the California Institute of Technology, the University of Chicago, Stanford University, the University of Illinois, and the University of Utah)

When asked which seminars or tours were preferred, 9 out of 10 students chose NIF, as epitomized by one student's words: "NIF—it is incredibly huge!" Aside from NIF, other popular tours included ASCI and CAMS. When students were asked which seminars or tours should be discontinued, the majority said, "Anything that happens at the Lab is interesting." A series of presentations called "Research: Methods, Manuscripts, and Money" was especially well-received. One participant commented that the series was "excellent. This is the real deal—stuff that will give LLNL interns a competitive advantage."

Student responses when asked to describe networking accomplished over the summer included the following:

- "Going to panel discussions, lecturers, and picnics were great opportunities for networking. I met other students, other Lab workers, and people from other agencies. Meeting other Lab students provided social opportunities. Lab workers branched out so that I was able to meet other Lab workers who were related to my major and helped me meet other people or introduced me to numerous resources (Web sites, scholarships, professors)...to help me with graduate school and career decisions. Through the panels, I met Dr. Gary Ellis, who has a great job that I wouldn't mind having one day. I obtained his business card and have been in contact with him. All of these people are just a wealth of information and have been more than helpful during my stay at LLNL."
- "I have gained contact with several professors with experience using equipment we purchased for the project; one of whom has expressed interest in helping me develop my project into a master's thesis."

## School-to-Career Panel Discussions

For the third consecutive summer, the Laboratory has held panel discussions. Once again this year, a series of three discussions was offered on the "School to Career" theme. Panel titles and topics, along with a list of panel members and their fellowships or organizations, are described below.

### **1. Graduate Opportunities: Advanced Education, Fellowships, and Scholarships**

- Dave Brown, Computational Science Graduate Fellowship
- John Holzrichter, Hertz Fellowship
- Satish Kulkarni, Student Employee Graduate Fellowship
- Jim Powell, National Physical Science Consortium
- Alan Wootton, LLNL Postdoctoral Program
- Moderator: Glenn Fox, Deputy Division Leader for Science and Technology, Chemistry and Chemical Engineering Division, and Program Leader, Forensic Science

Comments: "Great panel. Made me realize that I must attend graduate school in order to further my career." "This was very helpful for those of us thinking of advanced education."



*The panel members for “Young Researchers: New Careers, New Challenges”*

## **2. Graduate Research at University of California Campuses & MIT**

- Andre Lauchli, Associate Vice Chancellor for Research, UC Davis
- Robert Peccei, Vice Chancellor for Research, UCLA
- Robert Miller, Vice Chancellor for Research, UC Santa Cruz
- Roger Falcone, Professor, Physics Department, UC Berkeley
- Sidney Yip, Professor of Nuclear Engineering, MIT
- Moderator: Laura Gilliom, Director, University Relations Program

Comments: “They all had some good things to say—very informative.”

## **3. Young Researchers: New Careers, New Challenges**

- Kim Budil, LLNL B Division
- Bob Heeter, LLNL Lawrence Fellow and V Division
- Chrisma Jackson, Sandia, California
- Mariam Maghribi, LLNL Electronics Engineering
- Anne Platt, Sandia, California
- Moderator: Jim McGraw, Center for Applied Scientific Computing

Comments: “‘Young Researchers’ was the most informative to me about grad school.”

When asked whether panel discussions should continue in future summers, student responses were overwhelmingly positive. In addition, a number of students shared comments similar to the following: “Yes, I think overall everything was well-done. I plan on pursuing my Ph.D. now as a result of my research experience here at LLNL.”

## **Students-on-the-Go (Activities Proposed by Students)**

The Students-on-the-Go feature is one of the most popular sections of the SBB. Students and faculty posted numerous evening and weekend social and recreational activities, such as the following:

- Backyard football
- Hiking, mountaineering, backpacking
- Basketball (pickup)
- Road trip USA
- Los Angeles trip
- Skydiving!
- Smokin' Grooves Tour 2002
- Ultimate Frisbee (any skill level)
- Windsurfing and water sports at Del Valle Regional Park
- Death Valley on Labor Day
- Volleyball every day at noon
- Huge BBQ—fun times
- Giants tickets
- Giants vs. Athletics game Saturday
- The Good Times BBQ for everyone
- \$1 bowling Mondays, Tuesdays, Wednesdays
- Whitewater kayaking
- Indoor rock climbing (in Fremont)
- Phil Lesh and Friends or Tre Anastasio Sol tour
- Tchaikovsky showcase
- Weekly mountain bike rides

Although some students acknowledged that they didn't take full advantage of all the activities and networking made available through STEP, most students agreed that the activities were very helpful. Students felt encouraged to participate in social activities outside of work, enhance their summer experience, minimize feelings of isolation, and become acquainted with other summer students.

## Roommate Matching

An online student roommate matching service, first offered in FY00, was linked to the Human Resources Web site, enabling students to locate other roommates or post their names.

## Student News List

This mailing list is open to students and faculty participating in the summer programs, internships, and other activities at LLNL. Subscribers are encouraged to use the list to network while at the Laboratory and to update their e-mail addresses when they leave. Announcements and other information of interest to visiting students are posted on this list. On average, approximately 200 students register each summer.

Students have indicated that the mailing list is a good way to communicate with other students, receive new program information, and learn about upcoming seminars.



# Appendices



## Appendix 1: Lecture Series and Workshops

As part of STEP's effort to support student internships, STEP plays a major role in helping define, organize, and sometimes lead many LLNL activities to meet the Laboratory's broad education goals. In addition to assisting student interns with their research experiences, STEP offers interns a number of lectures and seminars to help them further their studies and career goals. All student intern events are based on the Laboratory's mission-oriented sciences.

Below are the instructional events offered to students working in the Defense Programs critical-issues programs during FY02:

### Nuclear Science Internship Program Lecture Series

URL: <http://internships.llnl.gov/nsip/>

All participants were required to take the following four Web-based courses:

- Emergency Preparedness Orientation Course (EM0001-W)
- Beryllium Awareness (HS4258-W)
- Integrated Safety Management (ISM) Orientation (ISO001-W)
- Chemistry and Materials Science Care ISM Training (CH1001-ISM)

All students participated in the following:

- Complex and Lab Safety Video
- Facility Radiation Safety
- TESA Lock Matters

Optional training, depending on each student's work setting, included the following:

- Fields and Waves (HS4370-W)
- Electrical Safety Awareness (HS5220-W)
- Video Display Terminal Ergonomics—Key Moves (HS5316-W)
- Hazardous Waste (EP0006)

Speaker: Dr. Kenton Moody, LLNL  
Nuclear Forensics

Speaker: Dabbie Schleich, LLNL  
Clear, Concise Poster Sessions

Speaker: Gerald J. Wasserburg, California Institute of Technology (CalTech)  
Between the Early Solar System and the Evolution of Galaxies

Speaker: Dr. Yuri Oganessian, Flerov Laboratory of Nuclear Reactions, Dubna,  
Russia (Director's Distinguished Lecture Series)  
Synthesis of Superheavy Elements: The Dubna–Livermore Collaboration



*LLNL scientist David Keyes discusses topics with students as part of the Internships in Terascale Simulation Technology Tutorial Lecture series.*

- Speaker: Prof. Darleane Hoffman, UC Berkeley/Lawrence Berkeley National Laboratory (LBNL)  
Nuclear Chemistry of the Heaviest Elements: One Atom at a Time
- Speaker: Dr. Bruce Lehnert, Los Alamos National Laboratory (Los Alamos)  
Radiation-Induced Effects in Unirradiated Cells: The Falling of a Central Dogma
- Speaker: Jay Davis, LLNL  
The Most Fun You Can Ever Have with a Low-Energy Accelerator
- Speaker: Glenn Knoll, University of Michigan  
Recent Trends in Radiation Detection
- Speaker: Joanna Fowler, Brookhaven National Laboratory  
Imaging Addiction in the Human Brain
- Speaker: Prof. Heino Nitsche, UC Berkeley/LBNL  
The Periodic Table, Actinides, and Selected Actinide Interfacial Processes Related to the Environment
- Speaker: Paul Keall, Virginia Commonwealth University  
The Management of Respiratory Motion in Radiation Oncology

## Internships in Terascale Simulation Technology Tutorial Lecture Series

URL: [http://internships.llnl.gov/itst/itst\\_schedule.html](http://internships.llnl.gov/itst/itst_schedule.html)

- |           |   |
|-----------|---|
| Speaker:  | David Keyes, Center for Applied Scientific Computing (CASC)<br>Topic: Scientific Discovery through Advanced Computing |
| Speaker:  | Pete Eltgroth, Scientific Computing and Communications Department (SCCD)<br>Overview of CASC Activities               |
| Speaker:  | Jeffrey Hittinger, SCCD<br>Simulating Laser-Plasma Interactions for Inertial Confinement Fusion                       |
| Speaker:  | David Keyes, SCCD<br>Terascale Simulations of PDE-Governed System   |
| Speaker:  | Bronis de Supinski, CASC<br>Overcoming the Memory Wall: Effective Use of Bandwidth                                    |
| Speaker:  | Alej Garcia, San Jose State University<br>Particle/Continuum Hybrid Methods   |
| Speaker:  | Gary Kumfert, CASC<br>Power Presentations   |
| Speakers: | Terence Critchlow and Carol Woodward, CASC<br>Tips for a Successful Interview   |
| Speaker:  | Erick Cantu-Paz, CASC<br>Problem Solving with Evolutionary Algorithms   |
| Speaker:  | Tanya Kostova-Vassilevska, CASC<br>Individual-Based Models in Ecology: A Herbivore Resource Model                     |

## Military Academic Research Associates Briefings

URL: [http://step.llnl.gov/mara/MARA\\_schedule.html](http://step.llnl.gov/mara/MARA_schedule.html)

- |                       |   |
|-----------------------|---|
| Speaker:              | George Sakaldasis<br>National Security Overview                               |
| Speaker:              | Captain Tom McCaffrey, Strategic Command Liaison Officer<br>STRATCOM Briefing |
| Speakers and<br>Tour: | Jim Ellis and Ron Basket<br>National Atmospheric Release Advisory Center      |



*MARA participants engaged at workstations at the National Atmospheric Release Advisory Center*

Speaker and  
Tour      Richard Langlois  
             Bioweapons

Speakers and  
Tour:      Craig Wuest, Mike Tobin  
             National Ignition Facility

Documentary: Explosive Situations

Speaker and  
Tour:      Bill Gilliam  
             High Explosives Application Facility

Speaker:      Milt Finger  
                 Department of Defense Technologies

Speaker:      Lt. Col. Mark Confer, USAF, Liaison Officer to LLNL  
                 National Nuclear Security Administration Overview

Speaker:      Glenn Fox  
                 Forensic Science

Speaker:      Ron Lehman  
                 Global Research Overview

Speaker:      Mike Uzelac  
                 JTOPS/Conflict Simulation Lab



- Speaker: Tom Ramos  
Counterproliferation and Analysis Program Briefing
- Speaker: Mary Beth Ward  
Z Division Overview
- Speaker: Major Mark Suriano, DTRA Liaison Officer  
DTRA Overview
- Tour: Ken Perkins  
Plutonium Facility
- Tour: Larry Sedlack  
Site 300

## Cybersecurity Lecture Series

- Speaker: Alan Riddle  
The Need for Standards in Vulnerability Name Assignment
- Speaker: Terry Brugger  
Moving beyond Standard Practice: An Introduction to Formal Security Models
- Speaker: Bill Orvis  
Malicious Code Dissection
- Speaker: Jonathan Emery  
The Road to Root
- Speaker: Jann Hayes  
Analysis of a Compromised System
- Speaker: John Rhodes  
The Legal Implications of Computer Security Work

## Summer Student Seminars/Panels/Tours/Socials

URL:<http://step.llnl.gov/sbb/>

- Event: Book Signing with Dr. Edward Teller
- Event: GRE Practice Test and Feedback Session
- Event: How to Create Effective Poster Presentations
- Event: LLNL Student Research Symposium

Event:	Allen Grayson, Bill Hoppes, and Chris Campbell
Event:	Research Methods, Manuscripts, and Money
Event:	MIT Information Discussion, Department of Nuclear Engineering
Event:	ASCI Alliance Information Session (University of Chicago, University of Illinois, Stanford University, University of Utah, and CalTech)
Social:	BBQ
Social:	Ice Cream Social
Speaker:	Kathy Puckett Inside the Mind of a Terrorist
Speaker:	Bill Orvis Malicious Code Dissection
Speaker:	Bill Dunlop Joint U.S./Russia Nuclear Nonproliferation Efforts
Speaker:	Jonathan Emery The Road to Root
Speaker:	Ruth Hawley-Fedder Fast-Growth Crystals
Speakers:	Terence Critchlow and Carol Woodward Tips for a Successful Interview
Speaker:	Al Ramponi Combating Bioterrorism: Scenarios and Science
Speaker:	Collette Patt, University of California, Physical Sciences Student Diversity Programs, Dean's Office—Letters and Sciences Graduate Admittance Myths and Discussions
Speaker:	Ed Moses National Ignition Facility
Tour:	Steve Asztalos Searching for Dark Matter Axions at LLNL
Tour:	John Knezovich Exploring Environmental and Biomedical Sciences with a Powerful Analytical Technique: Accelerator Mass Spectrometry
Tour:	National Ignition Facility

Tour: Simon Woodruff  
SSPX Spheromak

Panel: **Graduate Opportunities—Advanced Education, Fellowships and Scholarships**

Dave Brown, Computational Science Graduate Fellowship  
John Holzrichter, Hertz Fellowship  
Satish Kulkarni, Student Employee Graduate Fellowship  
Jim Powell, National Physical Science Consortium  
Alan Wootton, LLNL Postdoctoral Program  
Moderator: Glenn Fox, Deputy Division Leader for Science and Technology, Chemistry and Chemical Engineering Division and Program Leader, Forensic Science

Panel: **Young Researchers—New Careers, New Challenges**

Kim Budil, LLNL B Division  
Bob Heeter, LLNL Lawrence Fellow and V Division  
Chrisma Jackson, Sandia, California  
Mariam Maghribi, LLNL Electronics Engineering  
Anne Platt, Sandia, California  
Moderator: Jim McGraw, CASC

Panel: **Graduate Research at University of California Campuses & MIT**

Andre Lauchli, Associate Vice Chancellor for Research, UC Davis  
Robert Peccei, Vice Chancellor for Research, UCLA  
Robert Miller, Vice Chancellor for Research, UC Santa Cruz  
Roger Falcone, Professor, Physics Department, UC Berkeley  
Sidney Yip, Professor of Nuclear Engineering, MIT  
Moderator: Laura Gilliom, Director, University Relations Program



## Appendix 2: Student Research Symposium

URL: <http://step.llnl.gov/symposium>

Students in the Critical Skills Internships Program (CSIP) (<http://csip.llnl.gov>) are required to give oral presentations to their technical working peers at the conclusion of their research experiences. CSIP students are also presented with the option of participating in a Laboratory-wide student poster symposium in lieu of giving technical talks. Summer students who are not part of the CSIP are also able to participate in the Student Research Symposium if their schedules permit.

Feedback from researchers on the oral and poster presentations continues to reinforce the assessment that students gain knowledge and skills in their research areas that would not typically have been available at their academic level or educational institution. The students enjoyed the symposium experience and were happy with their posters and the opportunity to view other students' work. Hal Graboske, LLNL's acting Deputy Director for Science and Technology, described this year's symposium in the following manner: "I was impressed by the quality and breadth of the students' science-and-technology posters assembled for this event. As I mentioned to several managers, the quality of the students, the quality of the Lab S&Es [scientists and engineers] who were mentoring them, and the quality of the work were all first-rate—it looked just like a national-professional-society poster session."

The LLNL Laboratory-wide symposium seeks to promote undergraduate and graduate student research by enhancing students' first-hand experience of the research, exploration, and discovery processes that characterize working with scientific and engineering teams within a national



*The 2002 Student Research Symposium at the Laboratory's West Cafeteria*



*Hal Graboske, acting Deputy Director for Science and Technology, chats with a UC Berkeley student at the 2002 Student Research Symposium.*

laboratory. By providing a forum to experience the art of presenting technical research, STEP helps students develop an understanding of the scientific research process and expand their skills and knowledge within their academic fields of study.

Specifically, the Student Research Symposium increases awareness of student-research achievements, provides models of exemplary research, and facilitates student participation in the national scientific and engineering communities. In addition, the symposium creates a unique environment for celebrating and fostering appreciation of the valuable roles that students play in the research experience.

The FY02 LLNL Student Research Symposium, which was sponsored by STEP, was held in the West Cafeteria from 3 to 5 p.m. on Thursday, August 8, 2002. Seventy students presented posters at the symposium, while an estimated 215 Laboratory employees and guests came to observe the event.

New to this year's symposium was a program book (UCRL-MI-149475) that included research abstracts for all participants. In addition, the posters were displayed by discipline: biology (7),

chemistry and materials science (13), computation (19), engineering (14), environmental science (4), and physics (9), as well as four late submissions.

Representatives from UC Davis and the Advanced Simulation Computing (ASCI) Alliance campuses (the University of Chicago, the University of Illinois, Stanford University, and the California Institute of Technology [CalTech]) attended the symposium to recruit students for their graduate programs. The representatives also sponsored an information session as part of the summer student program. Two ASCI Alliance representatives (from Chicago and CalTech) provided unsolicited input following the symposium about the quality of the poster session. They specifically indicated that "the LLNL work compared favorably to like events at other labs."

## Appendix 3: Student Portfolios

### Introduction

Besides participating in oral and poster presentations, student interns in the Critical Skills Internships Program (CSIP) (<http://csip.llnl.gov>) are given the opportunity to have their school and research accomplishments listed on the CSIP student portfolio Web site:

**<http://internships.llnl.gov/portfolio/>**

The student portfolios are categorized by internship project. There is also a list of all portfolios created by FY02 students, including CSIP interns and summer students participating in the LLNL Scholars Employment Program.

Each portfolio includes the student's expected graduation date, grade point average (GPA), and e-mail address. The e-mail address allows students who are considering LLNL internships to contact recent participants. The GPA and expected-graduation-date categories were suggested by the LLNL Human Resource Department staff to facilitate recruiting possibilities.

Appendix 3 gives examples of the portfolios and respective posters of several FY02 STEP student interns, who are listed below according to their internship programs.

#### **Advanced Simulation and Computing (ASCI) Pipeline**

Karl Chen  
Dedaimia Kozlovsky

#### **Cyber College Defenders**

Bridget Benson  
Ian Webb

#### **Interns for Defense Technologies**

Robert Conway  
Darcy Kelly

#### **Nuclear Science Internship Program**

John Kurylo

#### **Reserve Officer Training Corps**

Jesse Greer  
Jennifer Hughes

#### **Scholars Employment Program**

Benjamin Fasenfest  
LaToya Moore  
Jenet Peng



## Bridget Benson

California Polytechnic State University, San Luis Obispo

**Major:** Computer Engineering

**LLNL Program:** College Cyber Defenders

**E-mail:** bbenson@calpoly.edu

**Graduation Date:** June 2005

**GPA:** 3.98

### *Project Description*

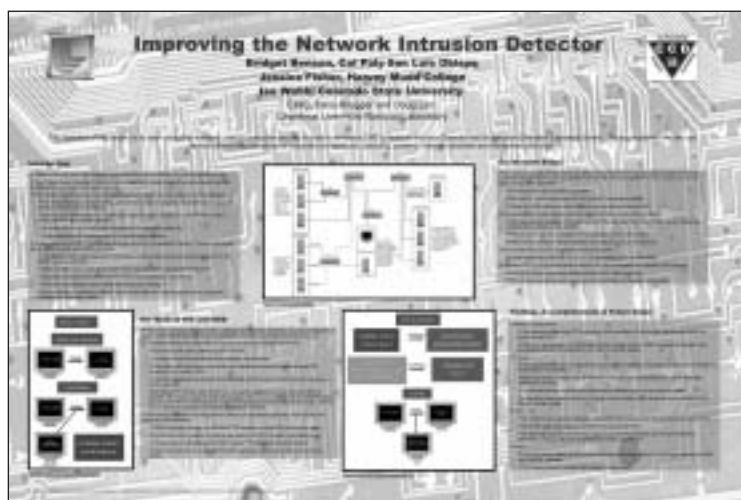
The College Cyber Defenders program gives students the opportunity to learn about the field of computer security. This summer, we explored

network intrusion detection (one aspect of computer security) by enhancing the Network Intrusion Detector (NID), which was developed by information-security professionals at LLNL. We enhanced NID by adding hundreds of attack signatures to its database and by updating its Web-based Intrusion Detection Exchange Server.

### *Impact on Education*

Participating in the College Cyber Defenders program made a significant impact on my education. I had originally applied to the program to get more experience in the field of computing to help

me decide if I should continue to pursue the major of computer engineering. After having the opportunity in the College Cyber Defenders program to learn about the field of computer security, apply the computer skills I have learned in school, and acquire new computer skills (e.g., UNIX, perl, sql, networking), I knew computer engineering was the right major for me. I realized there are many different and exciting areas of computing I could pursue with a computing degree.



## Karl Chen

University of California, Berkeley

**Major:** Electrical Engineering and Computer Science

**LLNL Program:** Computation/A Division/ASCI Pipeline

**E-mail:** quarl.llnl@quarl.org

**Graduation Date:** 2004

**GPA:** 3.8

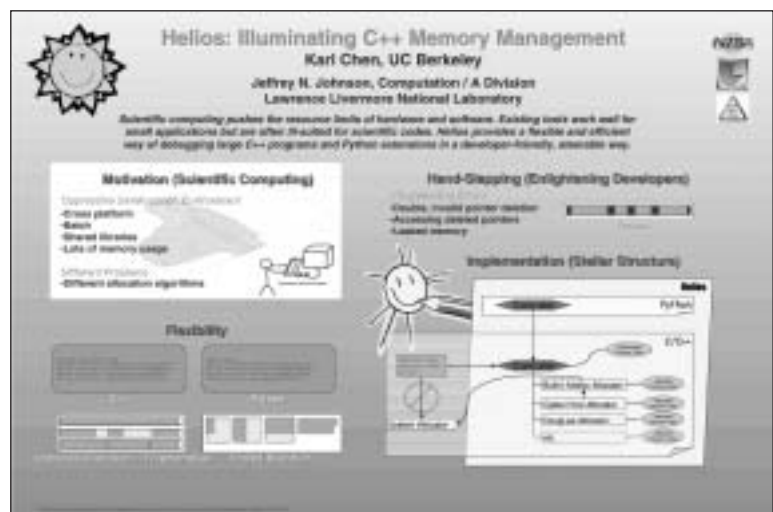


### Project Description

Helios is a memory-allocation software tool that provides a flexible and efficient way of debugging large C++ programs and Python extensions in a developer-friendly, steerable way. Helios was funded by STEP and the Internships for Terascale Simulation Technology and was developed for KULL, a Computation/A Division project. Although Helios was developed for a specific project, it can be useful in other C++ and/or Python projects within or outside the Laboratory.

### Impact on Education

LLNL gave me a great opportunity to get experience in computer science research by working on supercomputers. In addition to the diverse technical skills I gained, I also learned what a government research laboratory is like by programming in a large software project in a huge organization. Working here has opened my eyes toward graduate opportunities and other available paths I can take for my career.





## Robert Conway

University of California, San Diego

**Major:** Structural Engineering

**LLNL Program:** Defense Technologies Engineering Division

**E-mail:** sdconway2002@yahoo.com

**Graduation Date:** December 2003

**GPA:** 3.6

### *Project Description*

I verified the functionality of specific features of the ASCI Lagrangian explicit finite-element code that is currently in use at the Laboratory. This was done by meshing a multitude of problems with known analytical answers and comparing those to the

numerical ones. The errors were examined, as well as the rate of convergence for increasing mesh density. The experiments performed over the course of the summer, along with those conducted

previously here and at other laboratories, will provide future analysts with both a confidence in the codes that they are using and an idea of sufficient mesh density.

### *Impact on Education*

I have increased my knowledge about finite-element analysis, which I never would have obtained through academia. I have also acquired skills in using these programs. My time here has also given me more drive to obtain an advanced degree.



## Benjamin Fasenfest

University of Houston

**Major:** Electrical Engineering

**LLNL Program:** Defense Sciences Engineering Division

**E-mail:** bfasenfe@mail.uh.edu

**Graduation Date:** May 2004

**GPA:** 3.97

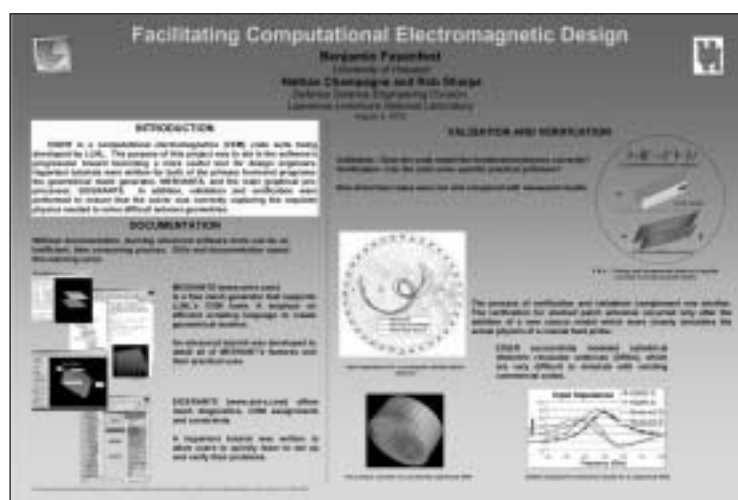
### Project Description

EIGER is an advanced software suite that is used to solve electromagnetics problems. The tools are being developed by a collaboration of national labs and universities, which is led by LLNL. The purpose of this project was to aid in the software's progression toward becoming more useful for design engineers. Hypertext tutorials were written for both of the primary front-end programs: the geometrical mesh generator, MESHANTS, and the main graphical pre-processor, EIGERANTS. In addition, validation and verification were performed to ensure that the solver was correctly modeling the requisite physics needed to solve difficult antenna geometries.

Antennas such as stacked microstrip patches and dielectric resonators were examined. Although these problems are difficult for commercial codes to model accurately, EIGER results showed excellent agreement compared with measured results. In addition to validating EIGER's ability to model realistic antenna problems, an improved source model was developed. This new model more closely simulates a coaxial feed probe used in many practical designs. The documentation and validation resulting from this project will help facilitate antenna design engineers' use of the software and increase confidence in their results.

### Impact on Education

My internship here at LLNL was directly related to what I'll be researching for my master's thesis. The University of Houston is one of LLNL's major collaborators on the EIGER project. My experience with the EIGER code suite here helped me to understand the functioning, applications, and design concepts behind it. In the fall of 2002, I will start researching and implementing expansions to EIGER.





## Jesse Greer

California State University, Fresno

**Major:** Electrical Engineering

**LLNL Program:** Counterproliferation Analysis and Planning System

**E-mail:** jlg71@csufresno.edu

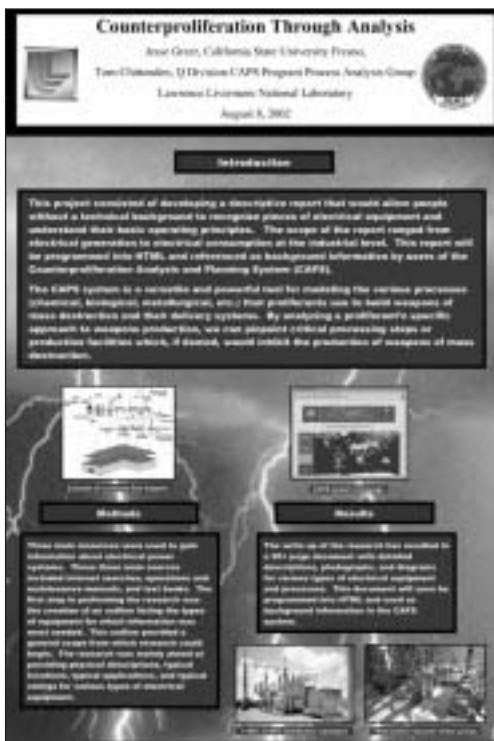
**Graduation Date:** Spring 2004

**GPA:** 3.6

### Project Description

My project allowed me to work with the chemical analysis team of the Counterproliferation Analysis and Planning System (CAPS). CAPS is a versatile and powerful tool for modeling the various processes (chemical, biological, and metallurgical, etc.) that proliferants use to build weapons of mass destruction

and their delivery systems. By analyzing a proliferant's specific approach to weapons production, the critical processing steps necessary for weapons production can be determined. Denying these critical production steps would then inhibit the production of weapons of mass destruction. My role in this program was to develop a descriptive report that will allow someone without a technical background to recognize electrical power equipment and understand the basic operating theory and applications of the equipment. The scope of the report included generation, transmission, and distribution power equipment. A great deal of emphasis was placed on the electrical equipment used at the industrial level. This report was programmed into HTML and will be implemented into the CAPS system as background information for CAPS analysts and users.



### Impact on Education

I was able to gain a much better understanding of the physical attributes and characteristics of power generation, transmission, and distribution equipment. This project allowed me to gain a practical perspective on power equipment that will supplement the theory and calculations covered in my engineering classes and enhance my overall understanding of power systems. I was also able to gain experience using HTML to create Web pages and practice my written communication skills.

## Jennifer Hughes

University of Notre Dame

**Major:** Mechanical Engineering

**LLNL Program:** Laser Science & Technology

**E-mail:** jhughes@nd.edu

**Graduation Date:** 2003

**Expected Degree:** Bachelor's Degree

**GPA:** 3.0



### Project Description

My project investigated laser-induced compressive residual stress in aluminum alloys. The goal of my project was to reduce the cost and complexity of the high-energy laser by using a low-energy laser to achieve comparable residual compressive stress. Laser peening takes an area beyond its plastic limit, treating what will move easily and then proceeds to build the stress level deeper into the part, while producing considerably low cold work. Therefore, a lower-energy, high rep-rate laser with a small beam footprint and more applied layers of shots produces better results than the current high-energy, lower rep-rate laser and less overlapping layers of shots.

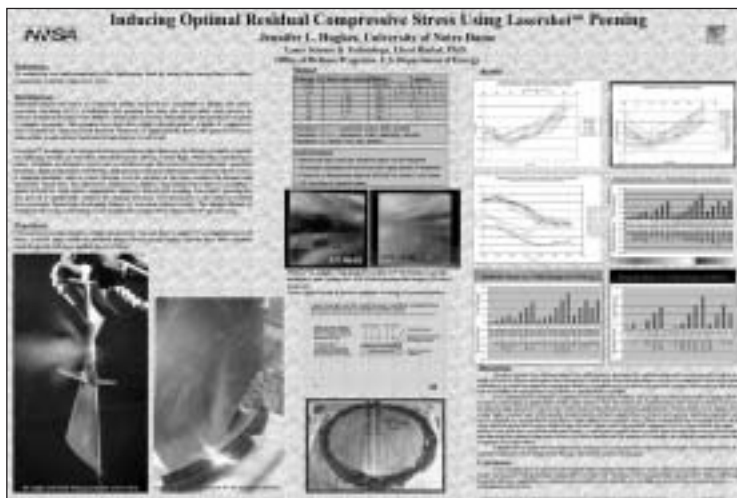
### Impact on Education

Even though I had a month-long naval training commitment during the summer, my department was very accommodating. Working within the Laser Science & Technology and Military Academic Research Associate (MARA) programs, I gained exposure to the research and development side of LLNL, as well as to the different projects and careers that exist among engineers, scientists, and military officers. Through the MARA program, I was part of the integration between LLNL and the military in developing new technology. I also toured many facilities and attended weekly briefings that were specific to military applications and goals.

I was responsible for learning how to operate a Tencor surface profilometer that had not been used for some time. I then taught my coworkers how to run it, which benefited other projects.

In order to benefit the most from this program, you need to take this opportunity seriously and dedicate as much time as you can during the summer to develop your research. Most projects take the entire summer.

My relationships with my coworkers and supervisors made the Laboratory a fun place to work and learn. They were very willing to help and were a great source of information. I had many opportunities to network with the Laboratory staff for possible future employment opportunities.





## Darcy Kelly

Massachusetts Institute of Technology

**Major:** Mechanical Engineering

**LLNL Program:** Defense Technologies Engineering Division

**E-mail:** darcyk@mit.edu

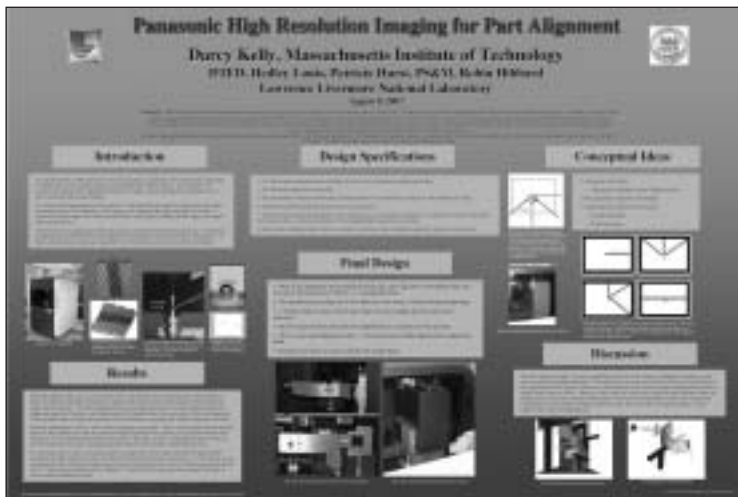
**Graduation Date:** June 2003

**GPA:** 4.6

### *Project Description*

The Panasonic 3-D Profilometer measures the surface of a target (typically 1 millimeter or less in diameter) using a stylus probe. To begin a measurement, it is important for the stylus probe to

be centered over the target. Currently, to center a target and engage the probe, an operator first aligns the target by eye. Next, the operator measures a small area and then uses that data to re-center the part. This process is time-consuming and usually takes several tries before the part is centered precisely enough to take a measurement of the entire target. In order to reduce the time it takes for an operator to align the target and to reduce the chances of a target being damaged by the probe tip falling off the edge of the target due to misalignment, a faster and more accurate method to locate and engage the probe needs to be developed. A target-alignment method has been developed using a rigid borescope connected to a CCD camera and monitor. By looking at the monitor screen, the operator will first be able to align the target in the  $x$ -direction, and then in the  $y$ -direction to better than 20 micrometers. The technician will then remove the borescope and measure the target.



### *Impact on Education*

By designing, building, assembling, and testing the attachment to hold the borescope, I feel that I have learned a lot more about the design process than through my classes in school. I believe that this experience will help me in my classes during my senior year.

## Dedaimia Kozlovsky

University of Wisconsin, Madison

**Major:** Computer Science

**LLNL Program:** A Division/KULL project

**E-mail:** dkozlovsky@students.wisc.edu

**Graduation Date:** May 2003

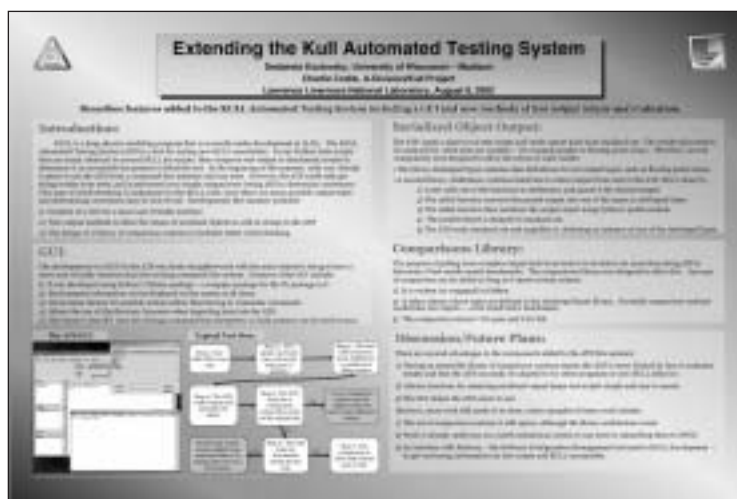
**GPA:** 3.85

### Project Description

I worked on extending the capabilities of a testing system for the KULL 3-D physics program. The Automated Testing System (ATS) runs a user-specified set of KULL jobs scripts and determines (based on previous runs or analytical data) whether the results produced by a KULL executable pass or fail. My main contributions were to design a new method of returning data from test scripts to the ATS and a library of comparison routines to use in determining correctness. New comparisons can be added to the library at any time, which gives the system a great deal of flexibility. I also created a graphical user interface (GUI) for the ATS and a new system for storing results and reference data.

### Impact on Education

Although I had used Python before, this summer was still quite a learning experience. I learned Python in much greater depth, especially specific packages such as Tkinter, which was used to create the GUI, and the bsddb3 module, which is used in the ATS database. I also learned to use Perforce, which was my first experience with using a software control/versioning system, and LaTeX. More importantly, this summer taught me what it was like to work on a real programming project, rather than on just a class assignment!



## John Kurylo

University of California, Los Angeles

**Major:** Biomedical Engineering

**LLNL Program:** Glenn T. Seaborg Institute

**E-mail:** JKurylo@ucla.edu

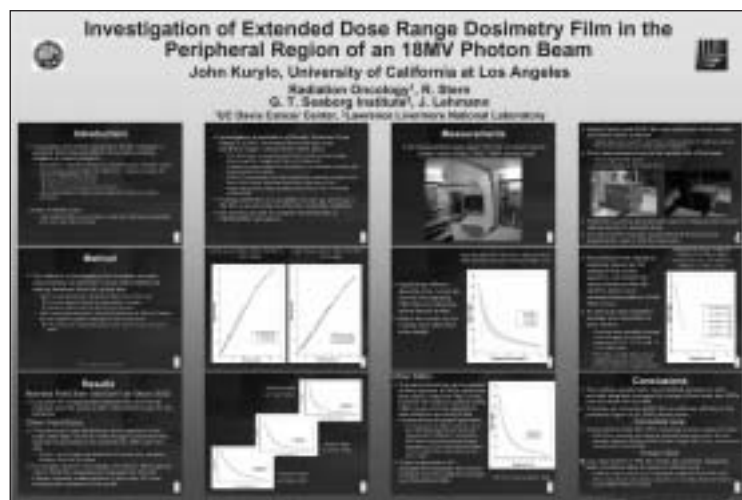
**Graduation Date:** June 2004

**GPA:** 3.8

### *Project Description*

The low-dose radiation project uses gene and protein expression profile changes to examine the biological effects of low-dose ionizing radiation in human subjects. Skin biopsies will be taken outside of the primary radiotherapy beam from patients undergoing radiotherapy for prostate cancer. PEREGRINE will accurately model the treatment accelerator and will calculate patient dose at the biopsy point.

We are investigating the application of Kodak's Extended Dose Range 2 (EDR2) dosimetry film in the low-dose peripheral region outside of the 18-megavolt beam. Radiation physicists use film dosimetry to look inside the beam edge, an area where spectral changes do not occur frequently. Outside the beam edge film dosimetry is problematic because the photon spectrum is essentially constant through the region for a given depth. The Kodak film promises to be less sensitive to spectral changes and has a more linear response than other dosimetry films. The water-equivalent plastic phantom acts like an oversimplified human body. By testing the EDR2 film on a simplified human, we will know if the film is as accurate as other film dosimetry methods and will be able to compare the film to PEREGRINE calculations.



The multiple sensitiometric curve method we used provided us with accurate weighted averages of a range of field sizes and surface source distances over the whole length of the film's profile. Therefore, we conclude because of the slight difference between the EDR2 film and the Farmer chamber measurements, maximum 5% error, EDR2 film proved to be extremely effective in the peripheral region of an 18-megavolt photon beam.

## LaToya Moore

Jackson State University

**Major:** Computer Science

**LLNL Program:** Electronics Engineering  
Technologies Division

**E-mail:** lagm2003@yahoo.com

**Graduation Date:** May 2003

**GPA:** 3.61

### Project Description

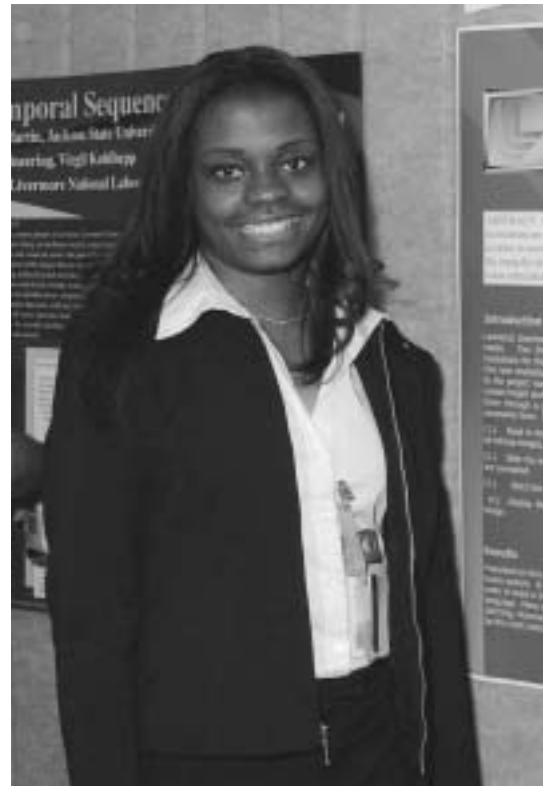
Cameras have been conducting surveillance in different areas of life for many years. In a given area, cameras are often set up at certain heights and angles to monitor any movements that are being made.

Most of the time, these cameras overlap one another and show the same actions. The Smart Camera

Project has developed a camera system to survey and analyze an area in order to monitor actions in that area. One of the subprojects is to obtain a panoramic view of the surveyed area. I helped develop an approach to fuse the camera scenes together. By using the programming language C, a program was written to read in images as 24-bit bitmap files. After being read in, the images are displayed, stitched together using a one-dimensional cross correlation algorithm; the stitched image is then displayed on the screen.

### Impact on Education

This project gave me the opportunity to learn a new programming language (C) and the chance to see how it can be used for imaging. This valuable opportunity allowed me to obtain experience in my field. I was able to view what is involved in electrical engineering. I have gained a tremendous amount of knowledge this summer and hands-on experience with material I have read in a textbook. Developing algorithms for image stitching was enriching because I had no prior knowledge of it.





## Jenet Peng

University of California, Berkeley

**Major:** Electrical Engineering/Materials Science and Engineering

**LLNL Program:** Chemistry and Materials Science

**E-mail:** jcpeng@uclink.berkeley.edu

**Graduation Date:** December 2003

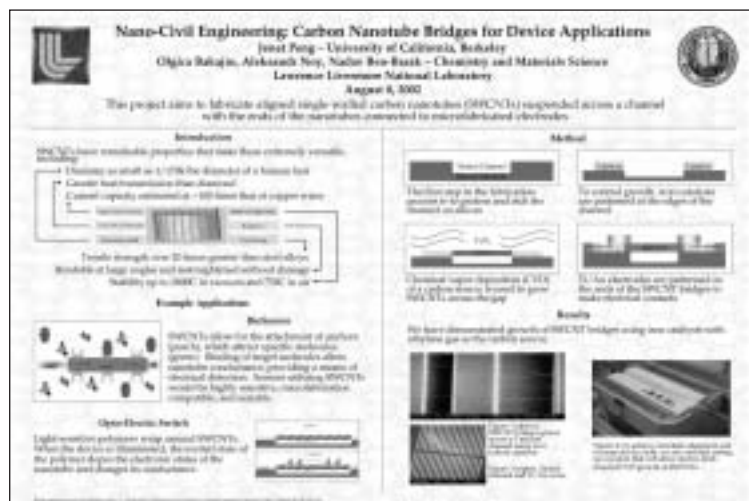
**GPA:** 3.74

### Project Description

The “Nano Civil Engineering: Carbon Nanotube Bridges for Device Applications” project aims to fabricate aligned single-walled carbon nanotubes (SWCNTs) suspended across a microfabricated channel with the ends of the nanotubes connected to

microfabricated electrodes. We are interested in using such nanotube devices as light-sensitive nanoswitches and biological and chemical sensors. To fabricate these devices, we are using a strategy that combines conventional microfabrication technology with catalytic chemical vapor

deposition (CVD) synthesis of carbon nanotubes. The first step in the fabrication process is to pattern and etch the channels on silicon. We then pattern the iron catalysts at the edges of the channels and use CVD to grow SWCNTs across the etched gap. We subsequently make electrical contacts by patterning titanium/gold electrodes on top of the ends of the SWCNT bridges. To achieve nanotube alignment and increase device yield, we are also setting up a system that will allow electric-field-directed CVD growth of SWCNTs.



## Ian Webb

Colorado State University

**Major:** Computer Science

**LLNL Program:** College Cyber Defenders

**E-mail:** webb@cs.colostate.edu

**Graduation Date:** December 2002

**GPA:** 3.7

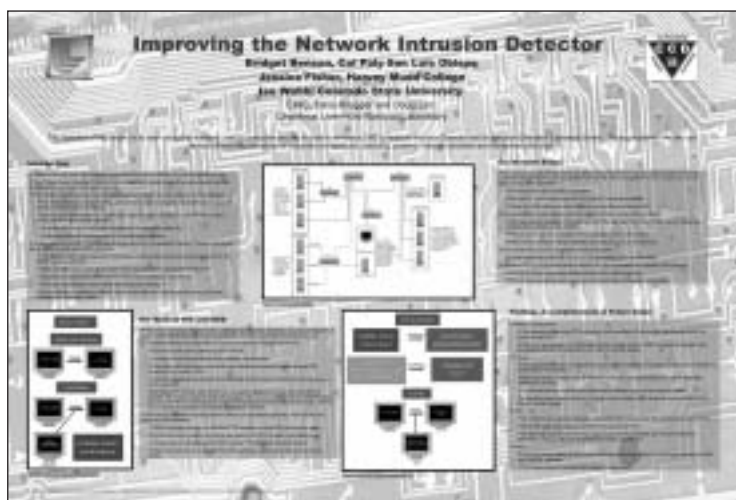
### *Project Description*

Computer Security has become an increasing concern in today's society. The College Cyber Defenders (CCD) program creates a pool of young computer scientists knowledgeable about computer security. Our project was to enhance the Network Intrusion Detector by adding more signatures to its database and updating the Web-based Intrusion Detection Exchange Server. We also worked on finding a reasonable network setup for future CCD programs to use.

### *Impact on Education*

My time in the Lawrence Livermore CCD program, has served to encourage me to continue with my pursuit of a career in computer/network security. While I have not changed the courses that I am taking, I see the possibilities that they will bring in a new light. I feel that artificial intelligence will have a great impact on computer-security issues in the future.

I am using my experience with the CCD to improve the Security Lab at Colorado State University. I am doing this with the intent of affecting the quality of other students' experience in a positive way, as well as increasing awareness of the Lab's CCD programs.





## Appendix 4: Student Interviews

### Introduction

An evaluation is completed at the end of the summer on each of these programs:

- Advanced Simulation Computing Pipeline
- College Cyber Defenders
- High-Energy-Density Physics Program
- Inertial Confinement Fusion Experimental Internships
- Interns for Defense Technologies
- Internships in Terascale Simulation Technology
- Laser Science and Technology Student Program
- Military Academic Research Associates
- National Ignition Facility Laser Internships
- Nuclear Sciences Internship Program
- Reserve Officer Training Corps Interns
- Systems Administration Computer Support

The purpose of the assessments is to provide an evaluation of the programs, both individually and collectively. The evaluation is conducted near the end of the program (during August and September, in the case of summer internships). Assessment tools include a measurement of student learning, a measurement of student satisfaction or rating of the internship experience, and an evaluation of the administration of the program.

The combination of these assessments is specific to each project; however, generalizations are appropriate and applicable for the many internship programs administered by STEP.

Because of space limitations, only the 21 evaluation questions are provided in this appendix. Student answers are available by contacting STEP's college intern manager Barry Goldman, (925) 422-5177, [goldman1@llnl.gov](mailto:goldman1@llnl.gov).

## Survey for Participants in the LLNL CSIP/STEP Summer Program, FY02

1. How did you find out about your internship?
2. Why did you choose to come to LLNL, as opposed to another institution?
3. How well did your research interests match your research project?
4. How did your research project relate to your academic background and education goals?
5. Did you have adequate work space, resources, and computer access?
6. How well did you get along with your mentor and other Lab personnel whom you worked with?
7. Were the directions given by your mentor clear and specific?
8. Did you gain further theoretical knowledge and practical experience in your research area through your internship experience?
9. What computer knowledge and skills did you acquire?
10. What is unique about this research internship and possibly not available through your university?
11. Was your experience helpful in broadening your awareness of LLNL's involvement in support of our NNSA mission of stockpile stewardship?
12. Describe your contribution to ongoing research in your project at LLNL.
13. How did your research assignment (if at all) influence or redirect your career interests?
14. If you are going to give a presentation upon your return to your campus about your experience at LLNL, what would you most want to talk about?
15. Describe any networking you accomplished . . . with other students, Laboratory scientific staff, etc.?
16. Describe which seminars/tours you preferred and why.
17. Describe which seminars/tours should not be continued and why.
18. Describe any other summer student activities/briefings/socials you participated on during your stay . . . and/or any you would suggest should be scheduled.
19. If you were in charge of this program, what changes would you make?
20. If you accessed the STEP 'Student Opportunities' Web site at [http://step.llnl.gov/step\\_student.html](http://step.llnl.gov/step_student.html), what improvements/changes will make it more helpful to new students considering LLNL for internships?
21. If you accessed the Student Bulletin Board Web site at <http://step.llnl.gov/sbb>, what improvements/changes will make it more helpful to new students considering LLNL for internships?



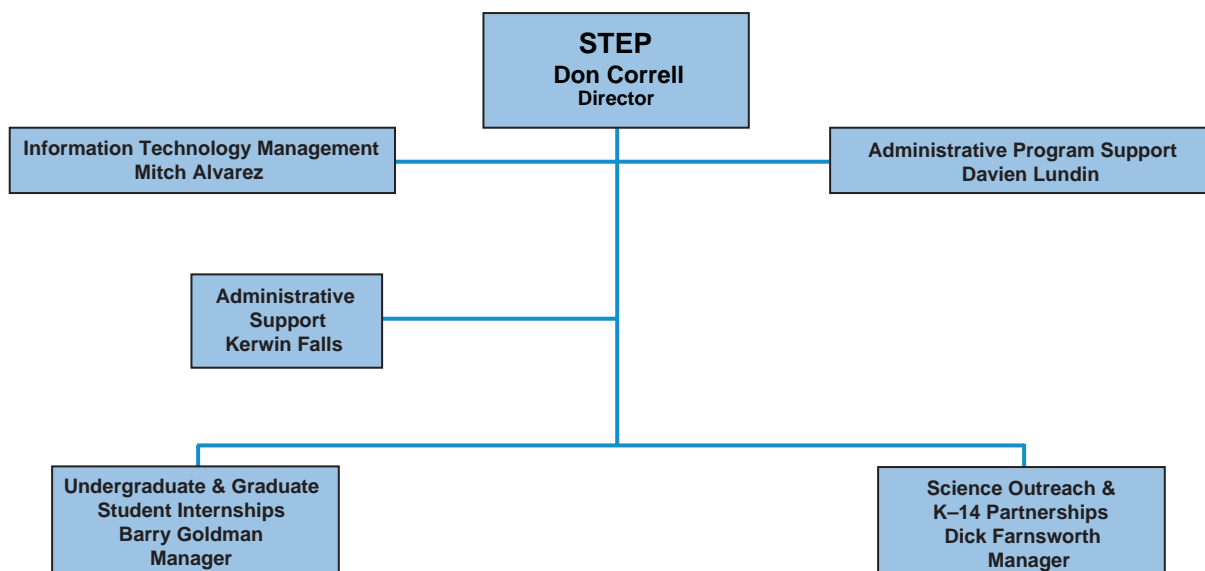
## Appendix 5: STEP Contact Information

Name	Phone Number	Fax Number	E-mail Address
Alvarez, Mitch	(925) 422-9631	(925) 422-5761	alvarez4@llnl.gov
Correll, Don (Director)	(925) 422-6784	(925) 422-5761	correll1@llnl.gov
Falls, Kerwin	(925) 422-6098	(925) 422-5761	falls3@llnl.gov
Farnsworth, Dick	(925) 422-5059	(925) 422-5761	farnsworth1@llnl.gov
Goldman, Barry	(925) 422-5177	(925) 422-5761	goldman1@llnl.gov
Lundin, Davien	(925) 422-5460	(925) 422-5761	lundin2@llnl.gov

### Science & Technology Education Program

Lawrence Livermore National Laboratory  
7000 East Ave, L-428  
Livermore, CA 94550

Phone: (925) 422-5460  
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